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THE ELEMENTS OF AGRICULTURE.

BY

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of the Royal Society in London, &c. &c. &c.

Tranſlated from the Original French,

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ADVERTISEMENT.

THE Book here offered to the Public, is a Tranſlation of *Les Elements D'Agriculture*, publiſhed lately at Paris by M. *Duhamel Du Monceau*, Member of the Academy of Sciences in France, and of the Royal Society of London, who is well known to the learned world, by his valuable treatiſes on various ſubjects, but particularly thoſe upon Huſbandry and improvement of Lands, in which he has ſhewn an uncommon zeal for the good of his country. The many difficulties, with which he encountered, being frequently repeated in his works, renders it unneceſſary to be here taken notice of: As alſo of his inducements for compiling this treatiſe, the author having given a full account of it in his Preface.

The Tranſlation is well executed, the true meaning of the Author is preſerved thro' the whole work, which is neither augmented nor abridged. The copy was carefully compared with the original, by

Chelſea, Nov. 17, 1753.

PHILIP MILLER.

THE

AUTHOR's PREFACE.

I Mean not to ſound the praiſes of Agriculture. That having been already done by very able men, it is enough for me to remark, that from the produce of the earth ariſe all the ſweets and enjoyments of life. By this conſideration alone we muſt be convinced, that this ſource exhauſted, every part of the community muſt ſuffer. What, in fact, is Agriculture? It is a ſcience which teaches us ſo to cultivate the earth as to enjoy its utmoſt produce; and, as the fruits of the earth are the moſt durable ſubſtance, the ſureſt ſupport of ſtates, and the true baſis of commerce, it follows that the earth properly or improperly occupied, the works of Agriculture well or ill executed, exert their influence on the riches or poverty of the inhabitants.

The world is no longer blind to theſe ſtriking truths: miniſters and magiſtrates now truly intereſt themſelves in this branch of government, ſo important to the commonwealth; whilſt our zealous citizens are diſintereſtedly and generouſly employed in making particular improvements: a concurrence of theſe two agencies is abſolutely neceſſary to make Agriculture flouriſh.

For many years, by inclination devoted to this uſeful labour, I have laid down ſeveral principles in Agriculture, ſupported, not by mere conjectures, but repeated experiments; but the reſolution I made not to advance any unſupported opinions, obliged me, in the Six Volumes I formerly publiſhed on the Culture of Lands, to make details of many experiments made in almoſt every province of this kingdom;

dom; inſomuch that the ſame fact is ſometimes mentioned and ſupported by new proofs in every one of thoſe Volumes. This was certainly the trueſt method of gaining entire credit. But ſeveral lovers of Agriculture have told me, that after having firmly eſtabliſhed my principles, it was proper to connect them, in a more compact work, and give them detached from ſuch details as, tho' at firſt neceſſary to gain them credit, are now become ſuperfluous; ſerving only to divert the attention of the reader, particularly the induſtrious Huſbandman who has neither time nor taſte to apply himſelf to the peruſal of large works. Theſe reaſons induced me to lay aſide ſeveral pieces I had begun, and write an Elementary Treatiſe, or true Rudiments of Agriculture, in which I have attended only to what is abſolutely neceſſary and uſeful.

Let it not be imagined that the principles which I have collected in this work are new matters of which the antients were ignorant. No, I publiſh them not as ſuch; they conſiſt frequently of methods uſed in ſome provinces, the utility of which it was neceſſary to point out, and which I was deſirous of introducing into others where they were not known. In one place they till the ground properly; in another they are better acquainted with the uſe of manures; whilſt in one country they ſucceed well in the culture of certain plants they are in that reſpect entirely ignorant in another, &c. It therefore ſeemed neceſſary to put it in the power of the Huſbandman to know, and reap his advantages from, what was well done elſewhere. Theſe are well eſtabliſhed truths, and derive their principal merit from their ſimplicity. For, not to deceive ourſelves, things too much complicated and refined are no ways ſuitable to wide-extended objects; and in this light we muſt view Agriculture. A refined Huſbandry which requires particular care and attention, ſcrupulouſly adhered to, may ſucceed in a ſmall farm, under the eye of an aſſiduous and intelligent proprietor; but in the hands of moſt Farmers, cauſes badly combined will produce effects entirely oppoſite to the primary views. I would have all prejudices and cuſtoms known to be bad, rooted out; but it ſhould be done by ſlow degrees, for it is not prudent to endeavour too ſuddenly to change cuſtoms long eſtabliſhed.

Tho' it has been thought proper to abridge as much as poſſible the details, yet is not this work thereby rendered obſcure.

General obſervations on the mechaniſm of vegetation; the beſt methods of breaking up lands; wherein conſiſts the beſt tillage, and what is to be expected from it. Of different manures, the means of procuring them, and the beſt method of uſing them; the choice and preparation of ſeeds, and the ſeveral ways of ſowing them; the care that is required during the growth of the grain; the manner of getting it in, threſhing, cleaning, and preſerving it; which are the moſt proper inſtruments of Huſbandry; of the uſe of natural and artificial paſtures; the methods of procuring them; the particular Culture of ſome uſeful plants; laſtly, a detection of ſome abuſes that are an obſtacle to the progreſs of Agriculture, are in general the ſubjects treated of in the Two Volumes I now preſent the public.

Was the public, for which we labour, to remain in a ſtate of inaction, in vain ſhould we endeavour to remove difficulties, and find out methods ſure, tho' ſimple; in vain ſhould we have ſubmitted all our principles to rigorous experiments, with a view of not deviating from truth; and in vain would many patriot citizens have jointly endeavoured with us to eſtabliſh the moſt intereſting facts. But happily we have no reaſon to apprehend this inactions: the miniſtry excite emulation, and this emulation has already been of uſe. True it is, that as the invitations I made to eſtabliſh a general correſpondence, were not merely formal, they have anſwered my intentions: for we now not only boaſt the ſingle labours of a few zealous citizens who communicated the progreſs they made to me, but there are meetings ſet on foot in the principal towns of the kingdom for theſe laudable purpoſes, devoted entirely to the public good, without any view of particular intereſt. Theſe reſpectable ſocieties will be the cauſe of an extenſive emulation, and not only improve the provinces, but, at the ſame time by their labours, acquire a large additional fund of knowledge to that they before poſſeſſed.

To be convinced of the real utility of ſocieties of Agriculture, one need only reflect, that tho' the fundamental principles of Agriculture are true, as reſpecting all kinds of earth, yet the methods of applying them muſt be varied according to the nature of the ſoil; the eſtabliſhment of theſe ſocieties, formed in almoſt every province, ſhould produce this ſalutary effect.

As citizens, we were overwhelmed with grief to ſee the ſtupidity that reigned in every thing that reſpected Agriculture. The Huſbandman, more by habit than deſign, drove his plow without having a proper path pointed out to him. There is, at length, room to hope that this lethargy is at an end; all the ſtates are animated with a deſire to make trials above the capacity of common Farmers. A lord aſſiſts his vaſſal to enable him to attempt a method of Tillage, which the meanneſs of his fortune had prevented him from undertaking; on the other hand, the magiſtrates give their protection to able Huſbandmen, and exert themſelves in ſoftening the rigour of thoſe laws which, tho' ancient, are not leſs inconſiſtent with the proſperity of Agriculture: an officer who has in his youth ſerved the ſtate in the army, often bleſſes himſelf at having it ſtill in his power, in an advanced age, to be uſeful to his country, and employs himſelf in Agriculture which furniſhes him with the opportunity. No clergyman in the country, if he performs the duties of his function, can have any ſpare time; many of them think the beſt method of employing their leiſure is to inſtruct their pariſhioners in the uſeful rules laid down in the good treatiſes of Agriculture, being careful to chuſe what is applicable to the nature of the ſoil, and, by uſing in their inſtructive converſations an idiom adapted to the capacity of the country inhabitants, make them conceive the methods intended to be inculcated, which, without this officious care, would not be within the compaſs of their underſtanding; and, in fact, there cannot perhaps be a better way of keeping them in the path of Virtue than by attaching to a way of life that naturally eſtranges them from Vice, and ought to inſpire them with ſentiments of probity.

I am acquainted with ſeveral perſons who, by ſetting a good example to the inhabitants of their diſtricts, have excited the emulation of their neighbours. To thoſe that have been well educated, precepts are doubtleſs very uſeful, but to Peaſants examples are needful.

We are in no want of Theoriſts who, without having any real knowledge in Huſbandry, from their deſks pretend to trace ſyſtems and lay down rules to Huſbandmen, which being merely ideal, too often lead thoſe aſtray who put any confidence in them.

In order to our lands being kept in good condition, it were to be wiſhed that the proprietors would themſelves improve them, or, at leaſt, direct the ſteps that might be taken towards it. The Farmers, ignorant of the improvements that have been made in Agriculture, and too poor to hazard experiments, are acquainted only with their old methods; and, as they are ſimple occupiers, their ſole view is to make as much as poſſible of the lands they hold, without regarding how much they impoveriſh them. The proprietors, who have commonly a greater degree of knowledge, aim at increaſing their rents, and aſſiduouſly endeavour to bring their works to perfection.

But nothing is of ſo much hurt to an eſtate as to let it to rich undertakers who engage for the rent. Theſe mercenary wretches make the moſt of every thing; they ſpoil the woods, neglect manuring the meadows; they ruin the Farmers and poor Cottagers. If any of them have it not in their power to pay their rent when it becomes due, their corn, cattle, and implements of Huſbandry, &c. are ſeized; provided theſe undertakers can make a large profit of their leaſes, their end is anſwered. Their obdurate and covetous hearts are utterly inſenſible to the complaints of the poor wretches they ruin. How different is ſuch a way from that of the good and humane Landlords before-mentioned, who promote the improvement of Agriculture.

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ELEMENTS OF AGRICULTURE.

BOOK I.

INTRODUCTORY OBSERVATIONS.

IF we would attend methodically to the progreſs of agriculture, qualify ourſelves to judge with preciſion of the culture of lands, and be fully ſenſible of the advantages one method poſſeſſes above another, we muſt firſt make a general examination into the nature of plants, the aſſiſtance they derive from their roots and leaves, the uſe of their flowers, the nature of the ſubſtance that nouriſhes them, and that of the land which furniſhes this nutritive juice. Theſe are the Introductory Obſervations capable of caſting a great light on the methods of practice that will compoſe the principal part of this work; of theſe it is my intention to treat in the firſt book, divided into as many chapters as there are matters to handle.

CHAP. I.

Of the difference of plants.

PLANTS are generally divided into annuals and perennials.

Of the perennials, ſome are ſo in all their parts, roots, ſtems, and branches: of this kind are all trees, ſhrubs, and under-ſhrubs. Others are only perennial in their roots, all that is above ground periſhing annually; for inſtance, Saintfoin and Lucerne. Of theſe ſome are more perennial than others; for the plants juſt mentioned are longer lived than Trefoil or Clover.

I comprehend among the annuals all thoſe plants which decay after bringing their fruit to maturity; whether they live only a few months, like the grain ſown in March; or longer, like the winter corn; or even if they live more than a year, as do Turneps and Carrots, which ſeldom produce their fruit till the ſecond year, and periſh when it is brought to maturity. So that in this treatiſe, which I mean to make as ſhort as poſſible, I ſhall pay no regard to the diviſion of plants into biennials, triennials, &c.

I ſhall give no attention to accidental variations: I ſhall, for inſtance, eſteem barley an annual, tho' I have ſeen a vigorous root from which, after harveſt, ſeveral new ſtems have ariſen, and lived the winter, producing ears the ſecond ſeaſon. I alſo know, that by means of ſlips made from the branches of certain annuals, their life may be prolonged; but as I mean not to give myſelf any trouble about theſe niceties in gardening, which are more curious than uſeful, I ſhall ſtick to the general diſtinction I have laid down, which will ſerve to explain what I ſhall hereafter ſay. I have only to add, that the branches of perennial plants are furniſhed with buds; and that theſe rudiments of branches are alſo found on the roots of ſuch plants as are only in that part perennial: annual plants have not theſe buds.

CHAP II.

Of Roots.

IN almoſt every ſpecies of plants, the roots, ſtems, leaves, flowers, and fruit, may be ſeparately conſidered; and as the culture which is beſtowed on the earth's produce, the tillage, the waterings, the manures, have a more immediate effect on the roots than on any other parts of plants, it naturally prompts us to take roots for the ſubject of this ſecond chapter.

SECT. I. *Of the Form of Roots.*

Roots are of various forms. Many plants have in the ground a fleſhy ſubſtance like an onion; theſe ſubſtances, which are properly called bulbs, are formed of ſeveral coats that encircle one another: of this kind are leeks, and onions uſed in kitchens. Others, as moſt kinds of lillies, have their bulbs formed of ſcales. It is proper to remark, that the ſubſtance which compoſes the body of the bulb, is not a true root. The root is a ſort of fleſhy ſcale, which ſupports the bulb; and it is this part produces the ſmaller roots, which extend themſelves in the earth, in ſearch of ſap to nouriſh the plants. The bulb is, properly ſpeaking, a bud, in which is to be found the leaves and flowers that appear in the ſpring.

The tubercles are productions reſembling in form the true bulb, but differ in having a uniform ſubſtance like the fleſh of apples, being compoſed neither of ſcales nor coats like the bulbs. The buds whence ſpring the like flowers and leaves, are on the outward ſurface. We may mention, for inſtance, the Saffron-plant, and Garlick.

I ſhall forbear noticing the varieties obſerved in the Sow-bread, Truffle, and Orchis, becauſe they are not cultivated; at leaſt, not for the middling rank of people. The Potatoe, and Jeruſalem Artichoke, have in the ground a large fleſhy ſubſtance, from whence proceed roots and ſtalks. Parſnips, Carrots, Radiſhes, and Turneps are fleſhy roots, that make their way into the earth, and draw their nouriſhment partly from ſmall fine roots, that extend themſelves on all ſides, but principally from the lower extremity of the vertical, or tap root. In proof of this, the Turnep, which is compoſed of a conſiderable ſubſtance on the ſurface of the earth, draws all its nouriſhment by a ſingle fibre, that penetrates into the ground. Other plants, and Aſparagus is of this kind, produce their roots in a bunch, that is to ſay, from one common center ſpring a number of roots, which, without ſeparating, extend themſelves in the earth, in form like the radii of a circle.

The root is the firſt thing produced by the ſeed; and this firſt root ſinks perpendicularly into the earth, forming what is called the tap. This tap is longer or ſhorter according to the nature of the ſoil, and the ſpecies of the plant; it compoſes the principal part in plants that have Turnep-like roots. In other plants, ſuch as the wheat kinds, this firſt root produces a number of lateral, or ſpreading roots: if theſe are very ſmall, they are called hairy, or capillary; if they are ſomething larger, they are named fibrous. Moſt trees and ſhrubs, and even plants that are perennial in their roots only, as Lucerne and Saintfoin, have larger roots, which ſpread themſelves in the earth, after the ſame manner the branches ſpread from the extremity of the trunk in the air: theſe are therefore called ſpreading, or branching roots. I ſhall not any farther enlarge on the form of roots; but ſhall proceed to ſay a few words on the nature of their unfolding.

SECT. II. *Obſervations on Tap Roots.*

The firſt production, then, of ſeeds is a root, which ſinks perpendicularly into the ground; and if it meets with no hard bed, or ſtratum, to oppoſe its lengthening itſelf, it penetrates to a great depth; this is what is called the tap root. It is on this account, that Parſnips, Carrots, Radiſhes, and other plants, the roots of which are the parts made uſe of, ſhould be ſown in deep land, or in ſandy ſoils, light and eaſy to be penetrated by their roots.

The lengthening of the tap root may be prevented in all ſoils; for it ſhould be eſteemed a general principle, that when a root is once cut, it lengthens itſelf no more; for the tap root then produces lateral, or horizontal roots, and t he ſe new roots being cut in the ſame manner, ceaſe to lengthen and put forth others: in fact, roots lengthen only by their extremities; ſo that whether they are ligneous, or herbaceous, they grow no more in length when the extremity is once cut off, tho' it is only half an inch.

Whether the tap root has been cut, or meets with a very hard ſtratum, or bed of earth that prevents its lengthening itſelf, or whether it continues to extend itſelf without any hinderance; in every caſe it produces lateral, or horizontal roots. But the cutting of the tap root greatly forwards the puſhing of the laterals; of which we ſhall treat in the next ſection.

SECT. III. *Obſervations on Horizontal, or Lateral Roots.*

1. Lateral roots are more or leſs ſtrong and vigorous, as they are nearer to the ſurface of the earth; ſo that if in planting a tree on level ground, the roots are placed at ſeveral degrees of depth, thoſe that are neareſt to the ſurface of the earth will be generally more vigorous than ſuch as are deeper; not only becauſe they are nearer at hand, to reap the advantages derived from rain, dews, the heat of the ſun, and the benefit of the air; but alſo, becauſe roots extend themſelves much more in tilled, or manured earth, than in that which is hard, and leſs fruitful.

2. Lateral roots extend themſelves in the ſame manner as does the tap root; like it they produce branches, which ſpread to the right and left; with this difference, that the branches produced by the tap root are more or leſs vigorous, as they are nearer the ſtem: on the contrary, in lateral roots which extend themſelves in the ſame layer of earth, many of thoſe branches that were near the trunk, periſh in proportion to the vigorous ſhoots that are made at the ends.

3. As lateral roots are particularly adapted to the collecting of ſap, they are by this extenſion carried every year into freſh earth, in a ſtate proper to furniſh them with this nutritive juice, which they tranſmit to all parts of the plants. This reſpects ſuch only as are perennial.

4. The diviſions and ſubdiviſions, which are almoſt infinite, would probably preſerve a very regular order, the ſame perhaps in all plants of the ſame genus, was not this regularity often deſtroyed by many accidents, ſuch as ſtones, and very hard clods, which oppoſe their extenſion, or inſects, or an inſtrument of huſbandry which cuts, or breaks them. Thus a root ſhortened, or cut, often produces others, and the mouths are encreaſed. This proves that it is rather of uſe, than prejudicial to plants, to cut ſome of their young roots in tilling the ground, provided it is not carried to exceſs. In ploughing, the ground is turned over; and ſome roots, inſtead of being broke, may only be removed from one place to another. In this caſe, they are ſurrounded with freſh earth, another advantage derived from tillage.

5. By many experiments, part of which I have mentioned in my Phyſical Treatiſe of Trees, I am

I am well ſatisfied, that roots extend themſelves much farther in looſe than in hard mould, and in rich earth, than in that which is more barren: this proves the advantages derived from tillage and manures. I am alſo ſatisfied, that in water there will ſhoot a great number of fibrous roots, which will extend very far without growing larger, and almoſt without branching. In the mud of bogs, roots extend almoſt in the ſame manner, but they grow larger than in water. In light and dry lands, a number of roots are ſent forth which do not grow in bulk. It is nearly the ſame in mould formed almoſt entirely of rotten dunghills. On the contrary, in good fat earths that are a little moiſt, and have ſome ſtrength, few roots are formed; but they are large, and well nouriſhed; this is particularly well adapted to trees and plants that are long lived. With reſpect to annual plants, the remarks I have made are leſs important: a number of roots collect a great deal of ſap, and form vigorous plants; and it is a matter of indifference in theſe ſhort-lived plants, whether their roots are ſo formed as to be of long duration. It is, therefore, of much more importance to annual than to perennial plants, that the earth ſhould be ſtirred.

6. It is aſtoniſhing to ſee the roots of Saintfoin, Lucerne, and ſeveral ſorts of trees, penetrate into very hard layers of earth. They have even, in a length of time, overthrown walls tolerably ſubſtantial. But when the roots meet with very hard ſtrata, the growth of perennial trees and plants is ſlower, and annuals die.

7. The ramifications of roots extend to a certain point, and the extreme diviſions become ſo fine, that it requires great attention to be able to diſcover the extremity of theſe roots, among the ſmall earthy particles betwixt which they inſinuate themſelves. Doubtleſs, theſe capillary roots are ſo many mouths deſigned to ſupply the plants with nouriſhment, whilſt the great roots are chiefly intended to ſerve as pipes, or tubes, to convey it to the trunk. I have brought proofs in ſupport of this in the Phyſical Treatiſe of Trees.

8. In taking up trees, or plants, after a hard winter, I have ſometimes remarked, that all the ſmall capillary, or hairy roots were dead; on the contrary, when the ſeaſon is mild, new ones are formed. This obſervation induced me to imagine, that in hard winters trees ſhed their capillary roots, nearly in

the ſame manner they do their leaves. This renewal of young roots may be uſeful to trees; but the loſs of ſmall roots is much apt to impoveriſh annuals. I have ſometimes pulled up plants of wheat after long and hard froſts, in which nothing remained alive but a kind of ſmall bulb, with a few very ſhort green leaves iſſuing from it, and this ſmall embryo of a plant was to produce new leaves and roots. I therefore eſteem it beſt, that the froſts ſhould not come on till the winter corn has gathered a little ſtrength; for then that which I called a ſmall bulb, being grown larger, will be able to make ſtronger ſhoots.

SECT. IV. *Obſervations on the Extenſion of Roots.*

In the preceding ſection, a part of what ſhould be the ſubject of the preſent has been already treated of; this may therefore be eſteemed a continuation.

1. Animals not being fixed to one ſpot, may go in ſearch of food, wherever they think they can find it. To a number of ſhell-fiſh fixed to the rocks covered by the ſea, food is brought by the water. But as plants are

not capable of a progreſſive motion, they have received an equivalent from the great Author of Nature, ſince annuals, by ſcattering here and there their ſeeds, are moved to ſpots where the earth is not drained of the juices they require. Some plants, ſuch as the wild Cucumber, and the Balſamine, caſt their ſeeds to ſome diſtance, by means of an elaſtic motion in their fruit. Other plants, the ſeeds of which are furniſhed with wings, or tufts, are wafted to a great diſtance by the wind. Bulbous roots and creeping plants renew themſelves by ſubſtances placed ſometimes above, ſometimes below, and often at the head of the plants that produce them; and theſe ſubſtances, by this means, are ſurrounded with a ſoil new to them. Finally, trees and perennial plants, by the lengthening of their ſmall roots, reach the earth they have not yet exhauſted.

2. We ſhould deviate then from the order of nature, in ſowing wheat every year in the ſame land. On the contrary, we comply with it in ſowing wheat in land reſted for a year, which time is wholly taken up in tilling it. This will in a proper place be explained.

3. Some trees and plants extend their roots much farther than others; which ſhews that ſome plants take up a greater ſpace of ground, and ſhould be ſowed or planted thinner, than others.

4. I have already remarked, that the extremities of roots extend very far. Tho' I avoid giving details of the experiments to be met with in the Treatiſe of Husbandry, and in the Phyſical Treatiſe of Trees, I cannot, however, forbear mentioning an experiment of Mr. Tull's, reſpecting the extenſion of hairy, or capillary roots.

A Carrot, or Turnep, for example, which ſeems to have only one large tap root, furniſhed with ſome filaments, ſends forth nevertheleſs, according to Mr. Tull, its capillary, or hairy roots to a conſiderable diſtance.

To be convinced of this, a field ſhould be pitched on, which has not been ploughed of a long time, and a triangular piece of ground ſhould be dug like A, B, D, C, pl. I. fig. I. twenty fathom long from A to D, and twelve feet wide from B to C, terminating in a point at the end A. There ſhould then be ſown in the length A D, twenty ſeeds of the large kind of Turnep, and care ſhould be taken to ſtir the earth frequently in this ſpot.

When the Turneps have attained their full growth, if that which is at the point A is the ſmalleſt, and they are gradually larger till you come to E, where the prepared bed is four feet wide, it may be concluded, that the roots of theſe Turneps have extended themſelves to two feet diſtance. If, on the contrary, the Turneps were nearly of the ſame ſize from E to D, there will be room to believe that the roots have not extended above one.

This is a very ready way to find how far any plant extends its roots. It nevertheleſs does not prove that the ſize depends abſolutely on the length of the roots; for as dried earth partakes of the moiſture of the adjacent earth that is wet, it may be concluded, that as the Turneps near E had the advantage of a large fallow unoccupied by any other plant, the earth which ſurrounded them received moiſture from the adjacent earth as faſt as it dried.

SECT. V. *Of the Shoots which Roots make.*

Roots are amply provided with buds proper to produce new ones, ſince it is obſerved, that a root when cut produces many others. The branches are alſo provided with root-buds, ſince ſlips and layers produce them. But the roots are more abundantly furniſhed with buds fit to produce branches, as I have amply ſet forth in the Phyſical Treatiſe of Trees. I have alſo made it appear in the ſame work, that as the buds of roots never unfold themſelves unleſs covered with earth, ſo the buds of branches appear only on ſuch as are expoſed to the air. Nevertheleſs, after the ſame manner that the branch of a tree, diſpoſed to put forth roots, produces them in a ſhady and moiſt ſituation, ſo does a root ſend out branches, when, being very near the ſurface of the earth, it is influenced by the heat of the ſun. In this caſe many trees and perennial plants make new ſhoots, which ſometimes appear at a conſiderable diſtance from the ſtumps, particularly when the trees have been lately felled.

The ſame thing happens to annual plants. The roots of a grain of wheat that has been buried at ſome depth in the ground, produce knobs, which are again covered with earth; and ſhoots are made by ſuch roots as are near the ſurface of the earth. This is the origin of branching, and there are circumſtances depending on the weather, which are particularly favourable to theſe productions. In cold winters and hard froſts plants are ſo far from producing roots or ſtems, that they loſe a part of the progreſs they had made in the autumn. On the contrary, in mild winters they make ſome progreſs, tho' ſlowly. When the ſpring is cold and dry, they are almoſt at a ſtand; on the contrary, cool and moiſt ſprings are very favourable to branching. If after a cold winter and backward ſpring there come ſudden heats, the grain runs quickly all to ſtalk, without branching. On the contrary, if the heats come not till the plants have made ſhoots both within and without the ground, there ariſe a number of ſtalks from a ſingle grain, and the crops are much encreaſed. It follows therefore, that whatever is favourable to vegetation, manures, plowings, &c. encreaſes the branching, and, of courſe, the crop.

SECT. VI. *Of the Uſes to which Roots may be applied.*

Hitherto we have only conſidered roots as relative to the plants which they ſupply with the neceſſary food. But, relative to ourſelves, the root is often the part that is in fact uſeful: Turneps, Carrots, and Potatoes, ſerve as food for men and cattle. Of Madder the root is the moſt uſeful part. In theſe different caſes it is therefore the growth of the roots that ought to engage our particular attention.

CHAP. III.

Of the Stems and Branches.

THE ſtems, or trunks and branches, are thoſe parts of vegetables which, ariſing out of the ground, ſupport the leaves, flowers and fruit.

SECT. I. *Of the Form of the Stems.*

The trunk of a tree is a column which riſes perpendicularly to a greater or leſs height, according to the ſpecies. It is compoſed of wood, ſap and bark. It would be too tedious to enter into an anatomical deſcription of theſe parts: ſuch as are willing to be informed on that head may conſult my Phyſical Treatiſe of Trees.

Shrubs and Under-ſhrubs are nearly of the ſame nature, except that ſeveral trunks often ariſe from the roots which, ſpreading into branches, form a kind of buſh.

With reſpect to plants that are perennial only in their roots, one would be apt to take them for Shrubs: nothing has that reſemblance more than a plant of Liquorice, or Lucerne. Nevertheleſs their ſtems periſh annually.

The ſame may be ſaid of ſeveral annual plants, except where their ſtems are herbaceous; for inſtance, large Beans. Others are climbing, as Kidney-beans and Peas.

SECT. II. *Of the Form of the Branches.*

In moſt plants, as well annual as perennial, the ſtem is divided into ſeveral parts, which form the branches. Nevertheleſs, the ſtraw of graminious plants, and the ſtalks of reeds, ſeldom produce branches. Theſe fiſtulous ſtems have knots, from whence iſſue the leaves.

SECT. III. *Remarks on the unfolding of Branches.*

Branches being a diviſion of the trunk into ſeveral parts, their texture is the ſame as that of the trunk. They ſhoot from the ſtems in a conſtant regular method, according to their ſpecies: ſome alternately; others are oppoſite; many, ſending forth their branches on every ſide by ſtories, are termed Verticilleous. Some kinds are cloſe to the ſtems, whilſt others are more or leſs ſpread. All theſe circumſtances give different forms to plants, and ſerve to diſtinguiſh the ſeveral ſpecies or varieties one from the other.

The ſtems and branches are provided with buds proper to produce branches or roots, as circumſtances differ. This I have already noticed in chapter II. If a branch is cut off, ſeveral others ſhoot forth, which repair the loſs. And this property is very uſeful, not only to trees but plants, ſince hence proceeds the great produce of artificial paſtures. If the extremity of a large Bean is cut off before it flowers, it puts forth ſeveral branches, and bears more abundantly.

SECT. IV. *Of the Uſe of the Trunk and Branches.*

The Roots imbibe the ſap: this ſap riſes by means of the trunk and branches, which nouriſh not only the leaves, flowers and fruit, but the roots themſelves; and it is certain that this ſap is prepared by the trunk and branches, which receive and convey it to the ſeveral parts that are fed by it.

The Branches bear the fruit-ſtalks, and, for the moſt part, the leaves. I ſay for the moſt part; for it is evident that the leaves of gramineous and arundenacious plants have their ſource from the knots of the ſtraws, and pipes that form their ſtems; and frequently, in herbaceous plants, the forks of the branches are furniſhed with leaves.

SECT. V. *Uſes to which the Trunk and Branches may be applied.*

With reſpect to foreſt trees, the trunks and branches furniſh wood for Carpentry and Building, alſo for Coopers, Turners, and Clog-makers. A great deal is burnt for firing. The ſmall twigs are uſed by the Baſket-makers, &c. The ſtems and branches of annual plants, and ſuch as are perennial only in their roots, have alſo their uſe: they furniſh almoſt all our fodder, and ſerve as food for cattle.

SECT. VI. *Thoughts on the Connection betwixt the Branches and Roots.*

I muſt not fail remarking, that plants produce roots only in proportion to their branches. So that it is a miſtaken opinion to imagine that the cutting of the ſtem and branches of a plant diſpoſes it to be more productive of roots; the contrary is fully proved in the Phyſical Treatiſe of Trees. Nevertheleſs, this ſhortning of the ſtem and branches is of no great detriment to plants that are perennial in their roots only, becauſe, if they were not cut, they would of courſe decay as ſoon as the ſeed had attained its due maturity. We ſhall mention this again when we treat of leaves.

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CHAP. IV.

Of Leaves.

LEAVES contribute as much to the ſupport and growth of plants, as their roots, tho' ſome are found that have none: as Muſhrooms; even ſome ſhrubs have ſcarcely any. But we may, notwithſtanding theſe exceptions, in general ſay, that all plants are provided with them; and for the moſt part, the branches of plants that have no leaves, are ſo tender as to ſupply their place.

SECT. I. *Of the different Form of Leaves.*

Leaves may be divided into two general claſſes, ſimple and compound leaves.

Simple leaves are only a ſpreading of the fibres by which they are faſtened to the ſtem or branch. Of this kind are the leaves of Cherry-trees, Sun-flower, Indian-creſs, and moſt ſorts of grain.

Compound leaves conſiſt of many ſimple leaves, which are then called Folioles: theſe are connected by one common ſtalk. Sometimes, beſides this common ſtalk, they have each a particular one. The leaves of the Acacia, the Horſe Cheſnut, Lucerne, Saintfoin, Peas, &c. are compound.

Simple leaves, as well as the Folioles of compound leaves, in ſome plants are thick and ſucculent; in others thin and dry. Some are ſmooth, others are furrowed on the upperſide, and have prominent ridges beneath: many are ſleek and ſhining, not a few rough to the touch, and ſome downy: ſome are tender, whilſt others are as tough as parchment. Moſt leaves are green, but of various ſhades: one ſide almoſt always differs from the other in colour. Some become in autumn of a brighter yellow, others of a fine red, and many are ſtreaked.

I ſhall not enumerate the different forms that ſimple leaves and the Folioles of compound leaves take; they are either intire or cut, notched, indented, &c. In this reſpect, the reader's curioſity may be ſatisfied by the Phyſical Treatiſe of Trees, where ſuch points are fully treated of, which are here but ſlightly mentioned.

SECT. II. *The Uſe of Leaves to Vegetables.*

Ceſalpinus ſays, that leaves ſerve to cover and protect the young ſhoots, flowers and fruits. If this was their only uſe, they would be almoſt unneceſſary when the flowers were gone, and the buds had acquired ſome degree of vigour. But many obſervations prove, that their uſe does not conſiſt in this alone.

Trees have been known to die when ſuddenly ſtripped of their leaves. Mulberry-trees, when the leaves are not gathered, make more vigorous ſhoots than ſuch as have been ſtripped. The ſhoots of trees are much ſtronger in years in which there are no inſects, than when the leaves are devoured by them; and I have obſerved, that they loſe many of their ſmaller branches when the leaves have been for ſeveral ſucceſſive years eat by the Caterpillars, or May-bugs. The inſect that only preys on the leaves of the Bon Chrétien pear-trees, hinders them from producing fine fruit. When the leaves of Corn are attacked by the Mildew, the whole plant is at a ſtand till it has produced new leaves.

The following obſervation proves alſo the uſe of leaves. As long as the trees make ſhoots, the fruit does not perfectly ripen: yet when I have been willing to haſten the ripening of it, by pulling the leaves, the fruit has been injured, unleſs it had attained its full growth, and was ready to ripen; then it was of uſe.

I could wiſh the lovers of Agriculture would try whether, if by ſtripping off a great part of its leaves at ſeveral times, a tree that was too vigorous might not be made to produce fruit, or the growth of a luxuriant branch be ſtopped.

The great importance of leaves to vegetation cannot then be doubted. In the next ſection we ſhall examine in what manner they operate, and what part they act in the vegetable ſyſtem.

SECT. III. *Of the Nature and Advantages accruing to Vegetables from Leaves.*

The Experiments of Mariot, Woodward, Dr. Hales, &c. make it evident that the leaves are the parts chiefly deſigned for tranſpiration in plants; and the greateſt part of the ſap imbibed by the roots, and which riſes in the trunk and branches, finds a paſſage thro' them. Leaves then are the ſecretory organs thro' which plants diſcharge their too great abundance of ſap.

In the Phyſical Treatiſe of Trees, in which we have treated at large of the tranſpiration of plants, may be ſeen, 1ſt, That Tranſpiration is ſenſible and inſenſible; 2dly, That when too plentiful, it weakens plants; 3dly, That the want of it cauſes conſiderable diſtempers in them; 4thly, We have determined what circumſtances are favourable or unfavourable to tranſpiration; 5thly, We have ſhewn what reſults from thence, with reſpect to the thriving of plants. As it would not be proper to enlarge here on theſe particulars, we refer to the work above quoted, where they are expreſsly treated of.

Several Naturaliſts have alſo proved, that leaves imbibe moiſture from rain and dews;

and that this refreſhment is of great ſervice to plants. Leaves then are capable of ſuction, and in concert with the roots, ſupply plants with food. This opinion is alſo diſcuſſed and ſupported by proofs in the above quoted treatiſe.

SECT. IV. *Inferences from what has been ſaid.*

From what we have obſerved it may be concluded, 1ſt, That in climates and ſituations wherein the roots are encompaſſed by a dry earth, plants may ſometimes be vigorous, if they enjoy the benefit of plentiful dews, and are not ſubjected to much tranſpiration.

2dly, Plants ſhould ſuffer leſs from drought on hills that are expoſed to the north than on ſuch as have a ſouthern aſpect; not only becauſe they tranſpire leſs, but alſo becauſe they imbibe the moiſture of the dews, to which they are part of the day ſubject.

3dly, If we obſerve that waterings in the form of rain are more beneficial to plants, than when the water is only poured on the roots; that in ſummer, waterings are more uſeful in the evening than at any other time of the day, the cauſe may as well be aſſigned to the imbibing quality of the leaves, as to waterings cauſing a decreaſe of tranſpiration, which in ſummer is too great.

4thly, If we take notice how uſeful it is to guard young plants, trees newly tranſplanted, and particularly ſlips, from the ſcorching heat of the ſun, muſt it not be allowed, that when we leſſen the tranſpiration we hinder the dews from diſperſing, which ſupplies the plants with a nouriſhment they could not receive from their roots, as young plants and trees lately moved are but badly provided with them, and ſlips have none at all?

5thly, This quality of imbibing may act in concert with the ceaſing of the tranſpiration to preſerve plants in proper order, which are put into wet moſs to be removed from one place to another.

6thly, The ſtripping off the leaves of 'ſcutcheons, cut in the month of Auguſt, is intended to hinder them from drying, by taking away the organs of tranſpiration.

7thly, It is evident that the abſtraction of the leaves muſt be hurtful to plants furniſhed with roots; not only becauſe it deprives them of an organ neceſſary to tranſpiration, but alſo becauſe they are thereby deprived of mouths that contribute to ſupply them with nouriſhment,

nouriſhment. The feeding down corn is not done with a deſign of adding to its vigour, but rather leſſening it, and thereby prevent its being laid by running too much to ſtraw.

8thly, This imbibing quality is ſometimes hurtful to plants; for inſtance, when the ſeaſon is cool and rainy, the plants that are ſheltered from the ſun and wind, receive more injury than others; becauſe their veſſels are, as it were, gorged with a ſuperabundant moiſture ſubject to corrupt: whence it follows, that ſome plants rot, whilſt others, more expoſed to the wind and ſun, are relieved by tranſpiration.

9thly, Plants raiſed under Bell-glaſſes, cloſe frames, or in hot-houſes, are in a moiſt atmoſphere, that may ſometimes be of ſervice to them; but which often ſubjects them to decay, if care is not taken from time to time to let out the ſteam. Such a neglect often occaſions the loſs of the greateſt part of the plants raiſed in this manner; for they fall to decay after having been for a time wonderfully thriving.

10thly, As the abſtraction of the leaves may be of uſe to check the growth of too luxuriant trees, by the ſame parity of reaſon the leaves of weakly trees ſhould be carefully preſerved. For theſe organs of tranſpiration are very neceſſary to give a new motion to the ſap.

SECT. V. *Obſervations on ſome other Properties attributed to Leaves.*

Some have extended the utility of leaves much farther, ſuppoſing that the nutritive juice diſtributes itſelf among the leaves, there to receive a final preparation; after which it is diſperſed into every part of the plant for nouriſhment. But as this opinion is founded on the circulation of the ſap, which is diſputed, we ſhall not in this place examine it.

Another faculty has alſo been attributed to leaves: for, as on a careful diſſection of leaves, there have been diſcovered pipes, and ſpiral veſſels, which ſeemed to contain nothing but air; and as Dr. Grew aſſerts, that he ſaw in leaves veſicles filled with air, ſeveral Naturaliſts have concluded from theſe obſervations, that leaves were the lungs of plants; that theſe organs received the air of the atmoſphere; that this air in the veſicles diſperſed itſelf even to the roots, by means of pipes or tubes; and that it had the ſame effect on the ſap as the air ſucked in by animals has on their maſs of blood. The following experiments ſeems to confirm this opinion, or, at leaſt, to demonſtrate that air eſcapes from plants thro' their leaves. This may be called *their expiration.*

If a bough, full of leaves, is plunged into water, bubbles of air may be ſeen on the leaves, which grow larger in proportion as the ſun which ſhines on the plant, acquires ſtrength; and when the cold comes they diſappear. This phænomenon might, with greater appearance of reaſon, be eſteemed a kind of reſpiration, as it was natural to think that the air muſt find a paſſage out, when that which was in the plant became rarified, and re-enter when it was condenſed. But, in the Phyſical Treatiſe of Trees, it may be ſeen that M. Bonnel has ſet aſide this ſyſtem, by proving that the bubbles did not come out of the plant; that they exiſted on the exterior ſurface of the leaves, and became viſible, when, by the rarefaction of the air, the bubbles were enlarged.

We muſt not hence conclude, that air is not neceſſary to vegetation: many probable reaſons are a proof to the contrary. The ſap appears to riſe in plants in form of a vapour, or, at leaſt, in a ſtate of great rarefaction.

tion. And, as it is certain there is a great quantity of air in vapours, it follows there muſt be ſome in plants. Probably this air, which does not ſtagnate, enters, and in ſome ſort renews itſelf in them.

The Air-pump, and a number of experiments, evidently prove much air to be contained in vegetables. But is this air mingled with the ſap, or has it veſſels peculiar to itſelf? I dare not decide this point. It may probably be aſked, where this air enters, and where it eſcapes? Some have aſſerted, it to be thro' the leaves only; others, thro' the roots; and many have been of opinion, that it finds paſſages in all the parts of plants. I ſhould be inclined to think, that it enters with the ſap, and eſcapes with the tranſpiration. I confeſs this is mere conjecture; for air can enter into vegetables in different ſtates.

That which eſcapes in great plenty from fruits in a ſtate of fermentation, had probably been deprived of its elaſticity; and, according to the experiments made by Dr. Hales, compoſed a part of their ſubſtance. In the action of fermenting, it reſumes its elaſticity, and becomes again fluid. Certainly, another portion of air in vegetables exiſts there, in the ſame ſtate as that which we breathe. If, as

Dr. Hales thought theſe plants had abſorbed air which had been deprived of its elaſticity, and that in ſome caſes this air ſhould reſume its elaſticity, even whilſt in the plants, it would certainly occupy a very large ſpace, by becoming like that which we breathe. To purſue this matter farther, it will be proper, in examining the air mixed with the ſap, to diſtinguiſh that which is collected in globules, from the other which, being more divided, is interſperſed among the groſſer particles of that fluid. But I perceive I am like to be engaged in diſcuſſions no ways ſuited to the practical treatiſe I am writing; on which account I ſhall attend to objects more immediately uſeful in huſbandry.

SECT. V. *Inferences drawn from the Uſe of Leaves to Plants.*

Leaves, in whatever light conſidered, are certainly very uſeful to plants, and it is not doubted but that plants receive conſiderable damage by being ſtripped of them. It is alſo with a view of weakening Corn that Farmers feed it down. When leaves are gathered in order to be dried to ſerve as food for cattle, it is done in autumn, when they are ready to fall; therefore the trees ſuffer little. The leaves of Lucerne, Saintfoin, and Clover, muſt of courſe be cut to procure fodder; but as this is done after their flowering, when the ſtalks are ready to periſh, theſe plants, which are perennial only in their roots, receive but little damage. This is not the caſe when they are fed down by cattle, which cropping the ſhoots of the plants as faſt as they are made, thereby greatly weaken the roots. We ſhall diſcuſs this matter more at large when we treat of artificial paſtures.

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CHAP V.

Of Flowers and Fruits.

IT is not probable that flowers were principally intended to pleaſe the eye or gratify the ſmell. Nothing is ſo beautiful as the variety of different flowers; nothing ſo delightful as the odour which ſurrounds them: but theſe advantages reſpect only ourſelves, and depend entirely on our taſte. A more ſubſtantial advantage in the Oeconomy of Nature is, the propagation of the ſpecies; and it is in the flowers that we meet with the organs of fructification.

A concurrence of the two ſexes is as neceſſary to make the ſeed fruitful, as to make an egg capable of producing an animal. There are then in plants male and female organs, as in animals; and of theſe organs the flowers are compoſed.

SECT. I. *Of the different Parts of Flowers.*

The coloured leaves called *Petals*, and which are the moſt agreeable parts of flowers, are not peculiar to either ſex. The male part of generation is the Stamina, by this name are called certain *Caſpulæ* of various colours, and *Apex*, ſupported by a *Filament*, generally very ſmall, and containing a fine duſt, *(farina)* eſteemed neceſſary to fecundate the female embryo. The female part is the pointal, compoſed of an embryo, or the germ, and of a filament or ſtyle terminated by what is called the Stigma, which in different plants has various forms.

Theſe different organs are often met with in the ſame flower: theſe flowers are called Hermaphrodites. But there are alſo flowers which have only the male organs, and others only the female: theſe are diſtinguiſhed by male and female. The Catkins of the Wal-

nut

nut and Hazel are male flowers; the female flowers are diſperſed in other parts of the ſame tree. The Panicles of Maize are the male flowers: the female flowers are at the joints of the plant, where the ear afterwards appears. In ſeveral kinds of plants there are individuals which bear only male flowers, and others which have only female flowers.

SECT. II. *Obſervations on Seeds.*

It is not yet preciſely known whether the embryos are fecundated by the duſt *(farina fæcundans)* contained in the ſummit of the ſtamen, or by an oily ſubſtance with which this duſt is impregnated. But let it be in what manner it will, there muſt ſtill be a concurrence of the two ſexes to produce a fruitful ſeed: ſuch as are not fecundated cannot propagate their ſpecies, and are often abortive.

A Hen that has no Cock, lays fewer eggs than another that has one, and her eggs are incapable of producing Chickens. It is the ſame in plants: ſome produce no fruit, others bear it; but unfit for propagation.

Let us purſue our compariſon. On opening a new-laid egg, no traces of the Chicken are ſeen; the animal ſhews itſelf by degrees, whilſt the bird ſits. The ſame is not the caſe with ſeed: the plant is formed in miniature, in what is called the Germ of well-conditioned ſeeds.

Theſe ſeeds are compoſed of one or more lobes, and of the germ, which contains the rudiments of the roots and branches.

On putting one of theſe ſeeds into the ground, the lobes imbibe a moiſture which diſſolves a part of their ſubſtance, ſo that they ſerve as breaſts to furniſh the firſt food to the young plant encloſed in the germ. The firſt part that unfolds is the root, which betakes itſelf to the earth in ſearch of nouriſhment for the ſtem; then the lobes become uſeleſs.

The remarks here ſlightly made, but which we have treated of at large in the Phyſical Treatiſe of Trees, are neceſſary for the underſtanding of what will in future be ſaid concerning fruits and trees: for it is evident that ſeveral of the diſeaſes of Corn may proceed from a defect of fecundation.

SECT. III. *Obſervation on Buds.*

Buds, in ſome meaſure, reſemble ſeeds, as under a number of ſcaly coverings the rudiments of the young branch are ſeen: but neither the lobes nor the young root are met with; becauſe this tender ſtem is connected with a tree which ſupplies it with the neceſſary food.

CHAP. VI.

Of the Sap.

MANURES rot, and the firſt preparation of ſap, by means of fermentation, is made in the boſom of the earth. The earth may then, in ſome ſort, be eſteemed the ſtomach in which the digeſtion of the nutritive juice of plants is performed.

The roots, which may be compared to the lacteal veins of animals, imbibe from the earth the juice which is to nouriſh the plants. This juice, on its entry into the ſubſtance of vegetables, is crude, and but little proper for nutrition. It undergoes various operations in the plant: and then takes the name of Sap, as the Chyle of animals takes that of Blood. After the ſame manner as theſe are ſeparated by means of different glands from the maſs of blood, juices particularly adapted to the nouriſhment of the bones, ſinews, fleſh, &c. ſo, doubtleſs, in vegetables ſecretions are made for the nouriſhment of the woody parts; thoſe which are tender and ſucculent; the ſhells of Walnuts; the coverings of Almonds; their internal ſubſtances, &c. But I ſhould avoid diſcuſſing theſe ſeveral matters. I ſhall dwell on two intereſting points only; the nature of the nutritive juice, and the manner in which it diſtributes itſelf into the ſeveral parts of plants. I muſt premiſe that I ſhall ſhall leave the ſubſtance of theſe points undecided, contenting myſelf with the relation of the reſult of ſome experiments, and ſeveral obſervations, which may be uſeful to ſuch as are willing to ſearch farther into the ſecrets of Nature.

SECT. I. *Obſervations on the Motion of the Sap.*

1. It is not to be doubted but the ſap riſes to the top of the largeſt trees, ſince it puts forth there, leaves, flowers, and buds. On the other hand, it is not likely that the moiſture extracted from the earth, by the roots, can immediately furniſh a nutritive juice. It is at leaſt very probable, that the juice which nouriſhes the roots has previouſly received preparations in the body of the plant, which make it proper for that function: whence I

conclude, that part of the ſap muſt deſcend from the branches towards the roots.

2. It is certain the roots extract with great vigour the moiſture that is within their reach, and that the mouths or imbibing pores are more numerous on the ſmall new-formed roots, than on thoſe that are larger.

3. Roots are not the only parts of plants that have this property, the ſtem and branches have it alſo; inſomuch, that a ſeparated branch ſtill preſerves a great power of ſuction.

4. This power of ſuction encreaſes when circumſtances are favourable to tranſpiration, and ceaſes as tranſpiration is at an end. The tranſpiration being in proportion to the tranſpiring ſurfaces, the leaves have, of courſe, a great power to attract the ſap. If the air, wind, and ſun encreaſe the power of ſuction, it is by being favourable to tranſpiration.

5. We muſt not, however, too haſtily conclude, that the tranſpiration of plants is the ſole cauſe of the motion of the ſap; for, in certain caſes, the ſap is in great motion, when there is ſcarcely any tranſpiration. In the ſeaſon when Vines weep, every thing is unfavourable to tranſpiration; nevertheleſs, the

motion of the ſap is evident: we may add, that the weeping ceaſes as ſoon as the leaves appear, which are known to be the principal organs of tranſpiration. Yet the tears are driven upwards with great violence; for Dr. Hales has ſeen them aſcend above twenty feet in glaſs tubes.

In the weeping ſeaſon the ſap riſes night and day; but more in the day than in the nigh, in proportion to the heat of the weather. If it is very hot, the liquor riſes apace in tubes, and there then riſes a great deal of air, which forms bubbles at the top of the liquor.

7. The ſap gets into motion at the beginning of the ſpring, or even as ſoon as the winter froſts are paſſed. Soon afterwards the unfolding of the leaves, flowers, and buds, ſhew that the ſap is not idle: then, as I have already ſaid, the tranſpiration becomes conſiderable, and the weepings ceaſe.

The violent heats of ſummer are, perhaps, leſs favourable to vegetation; becauſe too great a tranſpiration weakens plants, and it may be, becauſe the parched earth furniſhes very little ſuſtenance to vegetables. Whatever is the cauſe, it is certain that trees make commonly few ſhoots from the middle of June to the middle of Auguſt.

9. About that time the ſap ſeems to reſume its motion; the bark which during the preceding month adhered to the wood, ſeparates from it as eaſily as it did in the ſpring; the buds which had ceaſed ſwelling, make ſhoots. Many ſhrubs, which had flowered in the ſpring, produce flowers from this ſecond ſap—In a word, vegetation, which was languid during the heats of ſummer, ſeems to reſume towards the approach of autumn, a vigour almoſt equal to that it had in the ſpring.

The cold of the autumn puts a ſtop to the motion of the ſap; trees not only ceaſe making ſhoots, but alſo ſhed their leaves, and ſeem, as it were to die. Nevertheleſs, it is certain, even at that time, the ſap is in motion; for the bloſſoms are formed by ſlow degrees within the buds, and prepare for making an appearance in the ſpring; new roots are alſo formed in the earth,

11. It is not at all to be doubted but the warmth of the air is neceſſary to excite the motion of the ſap; that cold weather makes it languid; and that the winter's hard froſts ſtop it entirely,

12. It is not enough to keep plants, in air ſufficiently warmed, to make them vegetate properly: the immediate heat of the ſun is alſo neceſſary, without which they run up weak and ſlender.

13. The fruits of the earth are forwarded, or retarded, according to the weather; and nothing favours vegetation more than warm weather, accompanied with rain; cold dry weather is its greateſt enemy.

14. In a wet cold ſeaſon every thing rots; on the contrary, in hot, dry weather, every thing is parched up. But the circumſtances moſt favourable to vegetation, are when cloudy hot weather, inclinable to thunder, ſucceeds plentiful rains.

15. The moiſture that moſt helps vegetation does not proceed from waterings, but from rains and dews. Waterings are of more ſervice to plants when the weather is inclinable to be tempeſtuous, than when it is fine; and I have obſerved, that plants thrive more in one week of cloudy weather, accompanied with mild rains, than in a month's dry weather, notwithſtanding the utmoſt care taken to water them. Thence it is that the rain is almoſt of as much ſervice to aquatic as to terreſtrial plants; not on account of any particular

virtue in rain-water, but rather becauſe the ſame water produces very different effects, as it is made uſe of in hot or cold, fine or cloudy weather.

16. The ſucceſſive condenſation and rarefaction of the air, and of fluids, may, with great appearance of reaſon, be looked upon as one of the principal cauſes of the firſt preparation of ſap in the earth, and of its attenuation before it can enter the roots; and this ſame cauſe may, probably, have a great influence on its motion in vegetables, as well as upon its aſcent: on this ſuppoſition, the more frequent and powerful interruptions this rarefaction meets with from condenſation, ſo much the greater progreſs will vegetation make. This is the caſe in rainy, changeable, and tempeſtuous weather; and this, probably, is the reaſon that waterings are more ſerviceable at ſome times than others.

17. I do not aſſert, that the motion of the ſap depends ſolely on the condenſation and rarefaction of the air, and of fluids: other very powerful agents are found in Nature; perhaps ſome of them may produce the effects, the cauſes of which we are in ſearch of. Magnetiſm and electricity may be mentioned as inſtances, and induce us to ſuſpect,

that others exiſt which we are ignorant of, and which may co-operate in giving motion to the ſap. Several Naturaliſts have already made it appear, that electricity has an effect on vegetation. But tho' heat in general is neceſſary to vegetation, yet all plants do not require an equal degree of heat to make them vegetate.

18. It is probable the ſap in plants aſcends only by means of the ligneous fibres that extend even to the leaves and fruit; but it is a certain fact, that it can change its direction, and that it has a lateral or horizontal communication.

19. Many experiments prove, that part of the ſap returns towards the roots; and in trees, there is a probability that this reflux is made betwixt the wood and the bark.

20. Dodart and Hales, who deny the circulation of the ſap, agree, nevertheleſs, that it ſometimes aſcends, at others deſcends; but, with this difference, that, according to Dodart, theſe two juices are not of the ſame nature; and that they are ſeparately contained in veſſels peculiarly adapted to them: on the contrary, Dr. Hales admits of only one kind of ſap, which he ſays is contained in veſſels no ways different in their organization;

zation; and he aſſerts, that it aſcends or deſcends according to particular circumſtances; that it riſes during the heat of the day, and has its reflux when the air is chilled.

21. According to Parent and Mariotte, who admit of a real circulation, the moiſture by which the plants are fed, aſcends from the roots into the trunk, branches, leaves, flowers, fruit, &c. impregnated with qualities adapted to theſe ſeveral parts; and, after having depoſited what was neceſſary for their nouriſhment and growth, the remainder being ſuperfluons, deſcends into the roots, there to receive a new preparation: afterwards this fluid, being united to the new juices imbibed from the earth by the roots, re-aſcends into the upper parts of the plants.

22. I do not aſſert, that there is an actual circulation in plants; but, I confeſs, I am much inclined to think that a certain portion of the ſap aſcends for the unfolding of the branches, and that another part deſcends to perform the ſame operation on the roots.

23. As it appears to me, the reflux of the ſap, towards the roots, is not to be doubted; but I ſhall not thence haſtily conclude, that there is a circulation of the ſap.

24. It appears to me alſo, that all the proofs brought to eſtabliſh this circulation are inſufficient; yet I cannot think that the reaſons urged againſt it are ſufficiently concluſive. We muſt not, therefore, eſteem this queſtion decided either way; but rather make freſh efforts to clear it up in ſuch a manner as ſhall not admit of any doubt.

I ſhall conclude this ſection by referring to my Phyſical Treatiſe of Trees, ſuch as are deſirous of ſeeing the proofs of the propoſitions there to be met with. Let us now examine the nature of this nutritive juice: here alſo we ſhall content ourſelves with relating only the reſults of ſeveral experiments.

SECT. II. *Obſervations on the Nature of Sap.*

1. Several Natural Philoſophers have been of opinion, that the organs which ſerve for the firſt preparation of ſap, were to be found in the plants themſelves, imagining that the ſtomach of plants was ſituated betwixt the roots and the trunk. But as I could never perceive, in that particular ſpot, any different organization from what was to be met with in all the other parts of plants, it ſeemed to

me more natural to believe with others, that this preparation was made, as I have already ſaid, in the earth; where the water diſſolves the particles of earth and dung, proper for the nouriſhment of plants. Quantities of ſubſtances rot in the earth, and it is well known that putrefaction is the higheſt ſtate of fermentation.

2. As various ſubſtances have, by means of Chemiſtry, been extracted from vegetables, it has thence been concluded, that they ſerved as food to them. Conſequently, it has been thought that air, fire, earth, oil, and different ſalts, have entered into the compoſition of ſap; ſo that chemical analyſations would induce us to imagine, that earth was the chief food of plants; becauſe vegetables are by putrefaction reduced to earth; that ſalts could attenuate this earth, water extend its parts; and this water, with the aſſiſtance of fire, could give it motion, and a proper activity. But, according to this Hypotheſis, theſe different ſubſtances ſhould be in a certain fixed proportion mingled with the earth; for it is well known that too much ſalt makes the earth barren; that too much water drowns moſt plants; that too great a heat, and a ſcorching wind, dries them up, &c.

3. I do not controvert theſe general opinions; nevertheleſs, that we may not place too much confidence in chemical analyſations, let us reflect a little on the ſmall degree of knowledge that is to be acquired relative to the food of animals, by analyſing their fleſh and blood. Beſides, the knowledge of the ableſt Chemiſt does not extend ſo far as to extract from the moſt fertile earth the ſame ſubſtance they find in vegetables.

4. The Hyacinth and Narciſſus are well known to produce large leaves and fine flowers in pure water. In the ſame manner, I have raiſed almoſt all the Capillary plants, Pulſe, which has flouriſhed, and yielded fruit: and, what is more, ſeveral trees; and, among others, an Oak, which I preſerved ſeven years, by ſupplying it with water only. M. Bonnet has raiſed fruit-trees, and gathered fruit from them by uſing only moſs, which he kept moiſtened with water. Theſe experiments might induce us to think that water alone can ſupply plants with food; at leaſt, they ſerve to convince us that water makes a conſiderable part of the compoſition of ſap.

5. Nevertheleſs, it will be ſeen when we come to treat of Manures, that ſalts, dung,

and many other ſubſtances, ſome fat and oily, others ſaline, and not a few that are purely earthy, greatly promote vegetation. It will alſo be ſeen that ſomething elſe is neceſſary beſides pure water, to make a wholeſome ſap, at leaſt with reſpect to many plants.

If it could be made appear, that water was the only food of plants, we might thence conclude, that all plants required the ſame nouriſhment; but as we have juſt declared that the firſt propoſition is far from being proved, it cannot be improper to diſcuſs the ſecond.

Sect. III. *Whether the ſeveral Kinds of Plants require the ſame Nouriſhment.*

To take this matter in a general ſenſe, it does not ſeem probable that the ſame matter can ſupply ſuch a number of plants with food, which differ one from the other in appearance, in form, ſmell, taſte, and even in their properties: for it is not to be doubted but the internal parts of plants differ much one from the other.

But it does not thence follow that the nutritive juices differ whilſt in the earth, and before they have been modified by the organs of the plants. When we reflect that plants rob one another of nouriſhment by the roots they extend in the earth, we are even obliged to admit that the firſt nutritive juices are homogeneous.

It might indeed be ſaid, that as water enters largely into the compoſition of ſap proper for all plants, and as it is, at leaſt, a vehicle neceſſary to diſſolve the other conſtituent parts of the ſap; this vehicle, neceſſary to all plants, being abſorbed by them, the plants muſt, of courſe, ſuffer, as the other conſtituent parts of the ſap could not any longer be divided and diſſolved as much as was neceſſary, to enable them to enter the plants. But ſomething farther may be added; if, for inſtance, a Lettuce required any different food from that which ſupplies endive with nouriſhment, this Lettuce planted with Endive would thrive better than if planted among other Lettuces; Experience convinces us to the contrary. It is then certain that plants of different kinds rob one another of their food; and it ſeems as if this extended farther than the aqueous vehicle; but it can be made evident, that the ſame juice, imbibed by different plants, aſſumes various qualities. For inſtance, having taken a Lemon as big as a Pea, and grafted it by the ſtalk on the branch of an Orange-tree, it there throve, ripened, and ſtill preſerved its quality of a Lemon, without partaking in any thing of the Orange: this inconteſtably proves, that the juices of the Orange-tree received a different modification on entering into the Organs of the Lemon. All grafts prove the ſame thing.

Not content with thinking there were different ſaps for the nouriſhment of every plant, ſome would have it, that there were in every ſap particular juices to form every part of the ſame plant, or the ſame fruit. What a difference is there betwixt the fleſh of a Peach, the ſhell of its ſtone, the ſubſtance of its kernel, &c.? It was, therefore, thought neceſſary, that it ſhould have as many particular and diſtinct juices for the nouriſhment of each part.

It ſeems very probable to me, that the organs of plants ſo modify the ſap as to give a different flavour to fruits, and form the different parts of the ſame fruit; for with ever ſo much attention, no traces can be found either of the flavour or the ſmell of a root, in the earth that ſurrounds it; and in chewing the leaves and young branches, there is often perceived a total want of any thing analagous to the flavour, or the ſmell of their juicy and aromatic fruits.

Should any one aſk me how the ſame ſap can ſerve for the formation and nouriſhment of the ſhell of the ſtone, the ſkin of the kernel, and the fleſh of a Peach, I would, in return, ask the moſt able Anatomiſt, how the Chyle, which is the ſap of animals, can form the ſubſtance of the brain, the nerves, the membranes, the fleſh, the bones, the nails, &c. Theſe operations depend on a mechaniſm ſo refined and delicate, that it has eſcaped the reſearches of the moſt celebrated Naturaliſts.

Mariotte imagined, that in plants, this operation was performed in the roots; but by grafts, and many other obſervations, it is fully proved, that the organs capable of giving a modification to the ſap, exiſt in all the parts of plants; and if we ſometimes meet with imperfect Peaches, which taſte of the leaves of the tree that bore them, it is moſt natural to attribute it to a depravity of the organs deſtined to give a new preparation to the ſap that was to enter the fruit.

It is true, that particular taſtes are found in fruits, which ſeem to proceed from the earth in which the trees are planted, and which, on that account is called the taſte of the ſoil; but theſe taſtes, peculiar to certain ſoils, are equally met with in all the different kinds of fruit which grew in that ſame ſoil. Thence, I conclude, that there are certain juices, the taſte of which is not to be altered by the organs of vegetables; but this obſervation proves, that they are indifferently infectious to different plants, and that they mix with the nutritive juice, ſtill preſerving ſomething of their original character.

The ſame thing is obſervable in the animal kingdom. I have eat, at the late M. de Reaumur's, Chickens, the fleſh of which ſmelt of Garlick; becauſe they had mixed that plant with their food. In like manner, a Rabbet, which had been fed at M. de Maleſherbe's with nothing but Sage, had its fleſh ſtrongly ſcented with the ſmell of that plant. We may add, that Madder, mixed with the food of different animals, renders the bones, that are formed in the time it is uſed, of a very beautiful red colour. But theſe exceptions ſhould be no obſtacle to our concluding, in general, that aliments change their nature in the internal parts of animals and vegetables; to form in the laſt, wood, bark, and the ſubſtance of fruits, &c. and in animals, fleſh, tendons, bones, &c.

It is true, we cannot boaſt of having a perfect knowledge of any part of vegetables; but Grew, Malpighi, myſelf, and, I venture to ſay, all the Naturaliſts, have found on the ſurface of the roots only a ſpungy ſubſtance, which ſeemed indifferently diſpoſed to imbibe every kind of juice that preſented itſelf. If this is the fact, the juices muſt receive their qualities in the internal parts of plants; and what makes this opinion the more probable is, that I have raiſed in very clear, and very pure water, Capillary plants, bulbs of flowers, different kinds of Pulſe, and even trees; theſe plants have found, in this very pure water, wherewithal to furniſh themſelves with the lively ſmell of Balm, the ſweet taſte of the Bean, the acrimony of the Oak, the bitterneſs of the Almond, and the viſcoſity of the buds of the Horſe Cheſnut-tree; and, by a chemical analyſis, theſe plants yielded the ſame extracts as thoſe that were raiſed in the earth. Tho' the knowledge we have of the mouths or pores of roots is very contracted, yet is it poſſible to prove, that theſe roots indifferently imbibe juices of very oppoſite qualities. By a chemical analyſis, nitrous ſalts, vitriolic ſalts, and ſea-ſalt, are extracted from plants. It is not at all probable theſe three mineral acids ſhould have been formed in the plants.

I have, beſides, put the roots only of young plants in tinged or ſcented liquids, and have met with manifeſt traces of theſe liquids, even in the leaves and fruit. Some have alſo been of opinion that every thing capable of being diſſolved by water, indifferently finds a paſſage into plants; and this, with a few reſtrictions, may be admitted. But they have farther imagined, that each plant appropriated to its uſe only ſuch parts as were proper for its nouriſhment, the reſt paſſing off by tranſpiration: it is this point that cannot be allowed; for all that have examined the tranſpiration of plants, could perceive nothing in it but pure phlegm.

It is neceſſary to remark, that, by admitting that plants only appropriate to themſelves what is neceſſary, it would of courſe follow, that the earth would be as much impoveriſhed, as if all plants were fed with the ſame juice; for as the tranſpiration mingles with the air, and is diſperſed at large, it cannot well be ſaid to fall again on the earth, which produced it, and that this earth is fertilized by it.

An objection might be made to the identity of the nutritive juices of plants, by remarking, that certain ſoils ſeem more proper than others for the growth of certain kinds of plants; one ſoil is proper for Rye, another for Wheat, this for meadows, that for artificial paſtures, &c.; and the reaſon for this concluſion is, becauſe the nutritive juices of theſe plants are found there in greater plenty than elſewhere. I do not controvert this obſervation; but does this depend on the nature of the juices contained in the earth? or, may it not be attributed to another cauſe?

To oppoſe one obſervation to another, I ſhall remark that, in all appearance, the ſame earth can afford nouriſhment to every kind of plant. Thyme, which commonly likes a dry ſoil, will thrive, if planted in the earth of a marſh carried to the top of a hill; in like manner, a tuft of ruſhes will thrive in earth taken from the ſame hill, provided it is carried into a marſh. It does not then, in this caſe, proceed from the nature of the earth that Thyme grows naturally on the hill, and the ruſh in the marſh; but becauſe the ruſh requires more water than the Thyme, which would periſh in too moiſt a ſoil.

This may be carried farther. Botaniſts know that all plants, not only of our Temperate Zone, but alſo of the Frigid and Torrid Zones, live in the earth of our climate, provided they are ſo ſituated as to enjoy a degree of heat and moiſture ſuited to their conſtitution. This being premiſed, good earth appears to agree with all vegetables; and, in fact, the plants we meet with in a bad ſoil, grow with an uncommon vigour when found in fertile land.

We may add, that plants which bear largely, have occaſion for a greater depth of good earth. That which is only ſix inches deep, may afford nouriſhment to plants whoſe roots extend not very far in the earth, ſuch as almoſt all annuals. But this depth of earth will not be capable of affording ſufficient nouriſhment to Lucerne, much leſs to trees.

This, and other the like circumſtances, may be the cauſe that certain plants thrive better in certain ſoils than others, without attributing it to any eſſential influence that can proceed from the nature of the juices contained in the earth.

In order to ſupport the heterogeneity of the nutritive juices of different plants, it is farther remarked that, if a tree dies in any ſpot of age, another tree of the ſame kind being planted there, ſeldom ſucceeds; and that it is more proper to plant a tree of a different kind; becauſe, ſay they, the earth is exhauſted of the juices proper for the ſort of tree that died of age; but contains others proper for the nouriſhment of trees of a different ſpecies.

I allow that the difference of the nutritive juices furniſhes a very natural explanation to this obſervation; nevertheleſs, many other cauſes might be aſſigned. The tree which is ſuppoſed to die of age, may have died thro' ſome particular default of the ſoil, by means of ſome inſect's having deſtroyed its roots; or, perhaps, of a decay, cauſed by its being drained of its ſap by ſome paraſite plant, which has ſecretly robbed it: it may be even that the rotting of the roots of this old tree, or certain ſecretions which the earth may have imbibed, have rendered this ſoil unfavourable to that ſpecies of tree only.

But to continue our relation of the facts which ſeem to favour the heterogeneity of the nutritive juices of plants. All Farmers agree in thinking that it is beſt to ſow ſucceſſively in the ſame land different ſeeds; ſuch as Wheat, Barley, Oats, Peas, Millet, Turneps, &

&c. by this change, they can have ſucceſſive crops from the ſame land, which they could not have if they always cultivated the ſame kind of grain. After being convinced of this fact I ſhall remark, that if Barley ſucceeded well after Wheat, only becauſe the earth had retained the kind of juice proper for the nouriſhment of Barley, it would follow, that a good crop of wheat ſown on a barley-ſtubble might be expected, as the Barley would not have devoured the juices proper for the Wheat. Nevertheleſs, the crop of Wheat would, for the moſt part, be bad; becauſe Wheat does not ſucceed, unleſs the land has been prepared by three or four good plowings: on the contrary, Barley, which is leſs delicate, and requires not ſo much nouriſhment, ſucceeds tolerably well in a field that has had but two plowings. But this Barley would give moſt amazing crops, if ſown on land prepared as for Wheat.

It may be added, that if every plant only drew from land the juices adapted to its ſpecies, the year of fallow might be omitted, and the firſt year Wheat might be ſown, the ſecond Barley, the third Oats, then Buckwheat, Peas, Maize, Millet, &c. It muſt be allowed that by this method, continued without

out interruption for a number of years, but very weak crops would be got, the year of fallow being neceſſary to give the land the plowings requiſite to divide its parts and kill the weeds.

Another obſervation is made to prove, that plants of different kinds require not the ſame nutritive juice, which is, that a poor land left untilled, and ſuffered to cover itſelf with graſs, is at the end of a few years in a condition to give tolerable crops. In like manner, good crops are had from either natural or artificial paſtures, newly broke up, without the help of manures. Theſe lands, ſay they, inſtead of being exhauſted by the graſs they produced, reſemble freſh earth. If Corn ſucceeds well in paſtures broke up, it is probably becauſe the graſs, being nouriſhed by the ſurface of the land only, the inferior earth remains unexhauſted, being even meliorated by the rotted leaves and roots. Saintſoin and Lucerne ſhould be excepted from this rule, as they puſh their roots far into the land; and, perhaps, as they ſeek their food at a great depth, they do not exhauſt the ſurface. On the contrary, they enrich the land by their leaves, which rot; and this enriched ſurface is ſufficient for the growth of annual plants.

The moſt natural concluſion to be drawn from theſe obſervations, is, that plants do not render the earth barren, and that they never injure each other but during their growth; and if they do it then, it is, perhaps, by conſuming the moiſture, which is the chief vehicle of their nouriſhment. It is, probably, on this account that trees are killed when Saintfoin is ſown on the land in which they extend their roots.

We may ſay, with Mariotte, that the principles of which every plant is compoſed, are the ſame, at leaſt with reſpect to ſuch principles, as are moſt obvious to our ſenſes. If they have others peculiar to each plant, it is not in our power to ſeparate and demonſtrate them apart. To prove this propoſition by an experiment: Take a garden-pot with ſeven or eight pounds of earth in it, and ſow therein any plant you pleaſe, it will find in this earth, and the rain-water uſed to water it, all the principles proper for its nouriſhment. When it has attained its full growth, let the earth of the pot be ſtirred, and ſow another kind of plant, watering with rain-water as you did the firſt, and it will thrive; and in this ſame earth you may raiſe as many roots of plants as you pleaſe. But if the ſalts, oils, earths, &c. of every one of theſe kinds differed from each other, it would be neceſſary that all theſe principles ſhould exiſt in this ſmall quantity of earth and the rain-water uſed to water it; but this is impoſſible. For tho' each of the plants raiſed in the pot ſhould yield but one drachm of fixed ſalt, two drachms of earth, &c. all theſe principles, mixed with their diſtilled water and their oil, would weigh at leaſt two or three ounces; which, being multiplied by the number of the plants ſuppoſed to be ſucceſſively raiſed in the earth of this pot, would amount to much more than the weight of the earth in the pot.

After the experiments and obſervations which I have related, I muſt forbear making any poſitive concluſion on the nature of the nutritive juice of plants; and, notwithſtanding the ſucceſs of my experiments on the vegetation of plants in pure water, I am apt to think, with M. Mariotte, that the juices imbibed by plants are not ſo pure a water as that which I employed. It may, perhaps, be with theſe plants as with certain fiſhes, which live for a long time in the moſt pure water, but grow thin, and would in the end die if other food was not given them.

Our experiments will, at leaſt, undeceive ſuch as think this vegetative virtue depends on a pretended nitre, which many authors have taken occaſion to mention.

With reſpect to the preparations which liquids receive in the internal parts of plants, there is not the leaſt doubt but they depend on ſo refined a mechaniſm, that it has hitherto eſcaped our reſearches. Neither is this matter of ſurprize, ſince the ſame queſtion, with reſpect to animals, remains as yet undecided, notwithſtanding the reſearches of the moſt celebrated Anatomiſts.

What we have ſaid relative to the nutritive juice of plants, may induce us to be of opinion,

1. That many plants of different kinds are fed by nearly the ſame ſubſtance.

2. That there is no plant but what robs of food all within its reach.

3. That a ſoil once adapted to one kind of plant, will always be in a condition to ſupply it with food, provided it is properly cultivated.

We ſhall, in the courſe of our work, have farther occaſion to prove what we have now aſſerted. I ſhall conclude this Firſt Book with an examen of the different kinds of earth.

CHAP. VII.

Of the Earth.

THO' plants may be raiſed in pure water, on moſs or ſpunges kept moiſt, it is, nevertheleſs, in the boſom of the earth that ſeeds are moſtly depoſited; they generally germinate in the earth, and from the earth ſhoot their ſtems: ſo that of what nature ſoever the nutritive juices are, which plants imbibe by their roots, it is almoſt always from the boſom of the earth they extract them. This nutritive juice is to be found in more or leſs abundance in the different earths, from which it is collected with greater or leſs difficulty by the roots: this induces us to conſider the ſeveral kinds of earth, as they are more or leſs ſuited to vegetation, according to their degrees of fertility. Thoſe which contain moſt nutritive juice, and which are therefore moſt proper for vegetation, are called Loams, or Loamy Lands, or Mother Earth; the others are Clay, pure Sand, Marl, Chalk, &c.

Sect. I. *Of Loams, or Mother Earth.*

Loams are divided into white, brown, and ruſſet. The white lands are the beſt for Wheat. They are not ſo white as Chalk, Marl, or Virgin earth; they are termed White, becauſe when dry they have a whitiſh aſpect.

The brown Loam, tho' a little inferior to that abovementioned, is, nevertheleſs, very good for Corn; even when dry, it in ſome meaſure preſerves it colour. It muſt not, on account of its colour, be confounded with a ſoil of a very bad quality, which is very heavy when wet, and when dry has no coherence.

The ruſſet Loams are tolerably good for Wheat in wet ſeaſons; but if the ſeaſon is ever ſo little inclined to drought, they become much inferior to the brown and white Loams; therefore they are generally reſerved for meadows and artificial paſtures, particularly Saintfoin. Theſe ruſſet Loams muſt not be confounded with thered Clay uſed in building ovens.

All theſe Loams, which are by nature very fertile, ferment with acids; if when dry they are moiſtened, they ſmell like ſummer's rain. They are eaſily broke by the plow:

and they muſt be very wet before they become poachy. If plowed when very wet, they are apt to knead; and when ever ſo little dried by the ſun, form great clods. But as ſoon as the ſun has well dried and hardened theſe clods, the rain eaſily penetrates them; a fermentation enſues, bubbles of air are formed in them, and they moulder like lime: and, in the end, the earth being reduced to its firſt ſtate of culture, the roots are at liberty to extend to find plenty of nouriſhment. In very dry weather the weight of wheels reduces theſe lands to duſt; but in the fallows the earthy particles have ſtill ſo much coherence, as to prevent their being raiſed by the wind; which is often the caſe in light lands, where the roots of plants are left bare. When theſe lands have a proper degree of moiſture, they ſwell; they are more poachy than Sand, but leſs ſo than Clay. Of theſe three kinds of Loam, it is the white that is with moſt difficulty reduced.

In waſhing theſe earths I have obſerved a coarſe Sand, partly calcarious, partly vitrificable; then a finer Sand, which ſeemed to me to be moſtly vitrificable; laſtly a fine Mud, very different from the Clay which I have extracted from rich Sands. This I call Slimy earth; it is,

perhaps,

perhaps, partly formed of decayed vegetables; but I cannot venture to aſſert it. Acids diſſolve a part of this Mud: when expoſed to the fire it generally aſſumes a red colour, but does not bake like Clay; part of it ſeems to yield to the fire, and the reſt is reduced to Lime.

Sect. II. *Of Clay.*

Clay, called alſo Argil, is, if the expreſſion may be allowed, too earthy: it is very compact; but its pores are ſo cloſe, that roots with great difficulty penetrate it. It imbibes a certain quantity of water, which it retains; and when it is ſaturated, is no longer permeable to that element; when it dries after being poachy, it becomes very hard, and does not fall into duſt.

As it retains the water, all the ſoils that are ſituated on a bed of Clay, are moiſt; but as it only imbibes a certain quantity of water, it is always ſo compact that roots enter it with difficulty.

As poachy and kneaded Clay becomes very hard, it follows, that when plowed wet, inſtead of being divided, it is made more compact.

Clay, ſufficiently wetted, may be kneaded like dough. It is ductile, and ſhrinks in drying, ſo that its parts adhere ſtrongly; whence it follows, that it is with great difficulty penetrated by the ſun, dews, and roots.

Pure Clay does not viſibly yield to acids; they act very ſlowly on it.

Fire bakes Clay, which I eſteem a beginning of vitrification; nay, ſometimes a ſtrong fire melts and vitrifies it. Moſt clays become red by being baked on account of the iron they contain.

There are Clays of ſeveral colours, which ſeem to depend on the influence of metallic ſubſtances; thoſe which are very vitriolic appear to me to be leaſt proper for vegetation.

SECT. III. *Of Barren and Fat Sand.*

The water which clay retains only paſſes thro' ſand: or rather ſand admits of waters mixing with its particles, tho' they are not penetrated by it ſo that they only leave ſpaces which afford paſſages for the water without retaining it; on this account ſand ſoon dries.

Sands differ much, according to the nature of the particles which compoſe them. Some thro' a microſcope appear like fragments of cryſtal; others like fragments of flint; many reſemble ſmall cryſtals with a great tincture of iron; and not a few conſiſt of ſmall pieces of calcareous ſtones or lime-ſtone; whence moſt Sands vitrify in the fire, and ſome are calcined to lime. Many of them muſt alſo reſiſt acids, whilſt ſome yield to them, being of a calcareous nature: theſe laſt are ſtones reduced into very ſmall particles.

Water, in wetting ſand, ſo far from ſwelling it, as it does Clay and Loam, unites its parts, gives it ſome degree of firmneſs, and leſſens its volume.

Pure Sands permit roots to extend, but of themſelves afford no nutritive ſubſtance: they do not retain water, unleſs by frequent rains they are in a manner overflowed. Very hot weather deſtroys every thing on them, and the ſooner as the Sand heats ſo much.

A mixture of Clay with Sand makes what is called Fat or Rich Sand. This ſoil is very proper for trees, when it has a great depth. In general the fat Sand is very fertile, but hard to work, particularly when the Clay predominates.

When Sand, with a great mixture of Clay, is wet, it becomes very heavy, poachy, and ſticks to the tools. When dry, it is very difficult to plow.

When the Sand predominates, it is much eaſier to work: it hardens leſs in dry weather, and the roots make an eaſier way. I have waſhed it in a great deal of water, which I poured from one veſſel into another. After being left to ſettle, it has yielded partly pure Sand, and the reſt almoſt as pure Clay.

SECT. IV. *Of Marl and Crayon, or chalky Marl.*

Marl is an earth in itſelf as barren as pure Sand, but mixed with other earths, makes them as fruitful as the rich Sands.

Marls are of various kinds; ſome are found on the ſurface of the earth, others at a conſiderable depth. Some are hard, and, on coming out of the pit, reſemble Shards; others have the appearance of Clay: theſe feel doughy between the fingers; many kinds are not unlike Chalk; theſe the countrymen call Crayon, or Chalky Marl. This Crayon is ſometimes found above the fat Marl. Some are very white, others greeniſh, of a brick-colour or reddiſh, brown, &c.

Marls are often mixed with other ſubſtances. In ſome Marls there are many ſhells; in others Sand. The Shell Marls are generally very good; the gravelly kind are better or worſe, as they contain more or leſs gravel, unleſs when they are ſpread on clayey lands.

All Marls are not equally proper to enrich lands: thoſe called Crayon, or Chalky Marls, are quicker and more powerful in their effects; but their virtue does not laſt ſo long as that of the fat Marls. There are gravelly Marls which are almoſt of the ſame nature as Virgin earth. Theſe do more harm than good to lands, unleſs they are very rich.

The following characters may help to diſtinguiſh Marls from other kinds of earth.

1. On wetting Marl a little, it ſhould be unctuous, and fat to the touch.

2. In this ſtate it is almoſt as doughy and ductile as clay.

3. When Marl is expoſed to the air, it diſſolves and fall into powder, nearly as Lime does; this is not the caſe with Clay.

4. It ſhould diſſolve in water, and then its gravelly parts ſink to the bottom, and the true Marl lies over it in the form of a white Mud or Slime. Neither Chalk nor Clay diſſolve thus.

5. Marl ferments with all acids; but in Clay it is only the extraneous matter that can be affected by acids.

6. When Marl is expoſed to a briſk fire, it hardens a little, ſo as not to be ſo eaſily diſſolved in water; but it does not bake like Clay, nor become Lime like Chalk. There are, nevertheleſs, ſome ſorts which calcine into Lime, whilſt others are not difficult to vitrify.

7. Marl is an abſorbent earth, and will, like others of the ſame nature, take ſpots of greaſe out of cloth.

8. Marl ſhould not have a vitriolic taſte, but be inſipid, and have nearly the ſame ſmell as good Loam. This character diſtinguiſhes it from certain earths which diſſolve like Marl, but are, nevertheleſs, not proper to enrich lands. On this account, good Marl ought rather to turn green with ſyrup of violets, than red; for the bad earth of which we are ſpeaking, is a metallic and acidulous Marl.

It is well known that Marls at firſt render lands leſs fertile, but after a time enrich them much. We ſhall again treat of this ſubject in the Chapter of Manures in the Second Book.

SECT. V. *Of Chalk and Turf.*

Chalk is more of the nature of Stone than either Marl or Crayon; it is a ſoft ſtone, which roots cannot penetrate, and does not ſeem to contain much matter proper for vegetation. On throwing a little water on this earth it is immediately imbibed, it becomes ſofter and more ſlippery, but does not diſſolve. Nevertheleſs, when Chalk is cut by hand to encreaſe the ſurfaces of its parts, the rain, ſun, and froſt, fail not to break it; and, with the aſſiſtance of dung, it becomes capable of nouriſhing ſome ſorts of plants.

Some Huſbandmen affirm, that Chalk thus broke and ſpread on land has the ſame effect, as Marl; but I have not tried it. Chalk is diſſoluble by acids, and, on being calcined, is reduced to Lime.

Turf or Peat, is a fat earth: there are two ſorts: one is evidently compoſed of the decayed parts of vegetables ſoaked for a long time in water: the other alſo ſeems to be compoſed of the decayed parts of vegetables; but is very bituminous. Both of them burn, and depoſit aſhes very much mixed with earth, which the heat of the turf has calcined. The bituminous turf is leaſt proper for vegetation: that which is not ſo bituminous, makes a rich earth, when it has been well plowed, and is not overflowed; but it is too light. I apprehend it would be very good if it was mixed with earth that was too ſtiff; but I have not tried it.

SECT. VI. *Of Virgin Earth.*

Virgin Earth is ſuch as has never been ſtirred, lying lower than the plow goes. It is for the moſt part hard and gravelly, being of a middle nature betwixt earth and ſtone. It is of ſeveral colours, particularly white and yellow.

This kind of earth may be diluted in water, as mortar is made of it; but when dry it becomes very hard. It is by nature improper for vegetation; but by dint of plowing, and after it has been expoſed to the influence of the froſt, ſun, and meteors, and alſo aſſiſted by manures, it may be made fruitful; inſomuch that the earth which has been uſed for mortar, and is taken from old walls, makes good manure.

By waſhing Virgin earth I have met with much calcareous ſtone, and a ſubſtance reſembling chalk. I have ſpread it on land like Marl, but it has not ſucceeded.

I have alſo calcined it, and ſpread it on land; but hitherto it does not ſeem to have benefited it. Perhaps the improvement may not be viſible for ſome years.

I have ſeen ſome roots of Vine and Walnut-tree that have been penetrated pretty far into the Virgin earth; but moſt roots run along its ſurface, without penetrating it.

I avoid ſpeaking here of Boles, which are a ſort of clay; Tripoli, which partakes of the nature of Chalk; and Ochre, which is a ſort of Iron Ore; becauſe theſe earths are in themſelves but little adapted to vegetation, are found only in veins, or ſmall ſtrata, and never make the bulk of lands in Tillage.

SECT. VII. *Of Soils too ſtrong or too light.*

The nutritive juice of plants would be to no purpoſe depoſited in the boſom of the earth, if the plants were not able to collect it. There muſt be ſome means for them to extend their roots betwixt the particles of earth. A ſoil too rough, compact, the particles of which are too near each other, prevents them from doing it. It is then neceſſary that theſe particles ſhould have betwixt them certain interſtices thro' which the roots may find a paſſage.

Moſt ſoils have naturally internal pores; but they are generally either too ſmall, too numerous, or but ill adapted to the roots.

If they are too ſmall, as in heavy lands, few roots can enter them: this is one of the greateſt defects of Clay.

If, tho' large enough, their number is ſmall, it will often happen that there is no communication betwixt one pore and another; and the roots being ſtopped in their progreſs, cannot extract the nouriſhment neceſſary for the plant: this is one of the defects of too ſtrong ſoils.

If the interſtices are too large, the roots paſſing them almoſt without touching the earth, will receive no benefit. This is a defect peculiar to light lands.

SECT. VIII. *Means of remedying theſe Defects.*

A ſufficient tillage will, in part, remove theſe defects; for, in many inſtances, the earth contains ſo great a quantity of nutritive juice, that there is no danger of exhauſting it. It is then only neceſſary to aſſiſt the roots, to enable them to reap the benefit of it. There is ſtill leſs reaſon to apprehend this nouriſhment

ment will diſperſe of itſelf; experience proves it will not. Let earth be dried, pulveriſed, expoſed to the ſun, rain and froſt, it will become only more fruitful.

It is certain that water ſhould diſſolve the parts deſtined to nouriſh plants; and that this vehicle is in a great meaſure diſperſed by tranſpiration, after it has depoſited in the plants what was to be converted into their ſubſtance. But when water evaporates from the earth without paſſing thro' plants, it carries with it none of thoſe nutritive particles; ſince, as we juſt remarked, lands left in a ſtate of reſt, inſtead of being impoveriſhed, became more fertile.

Beſide, experience convinces us that the ſurface of the earth, which is moſt frequently ſtirred, and moſt expoſed to this dreaded evaporation, is always moſt fertile.

Thence it follows, that to encreaſe the fertility of land, it is not only neceſſary to furniſh it with matter proper for the nouriſhment of plants, but it muſt be ſo managed that the plants may, with their roots, be able to collect that nouriſhment which almoſt every kind of land abounds with. For this purpoſe, it is neceſſary ſo to divide the particles of earth, that there may be betwixt them an infinite number of ſmall ſpaces, thro' which the roots may inſinuate themſelves; ſo that, being in immediate contact with the particles of earth, they may imbibe the nutritive juices. This diviſion of parts may be effected by plowing and manures, as we ſhall hereafter explain.

SECT. IX. *Of Soils that ſuffer the Water to paſs, and ſuch as retain it.*

Earth alone would not be ſufficient for plants; water is ſtill more neceſſary to them. If this help is wanting, they betray a viſible inanition; their leaves wither, dry, and fall. Theſe ſymptoms ſhew that they either want water, or that their tranſpiration is too abundant. Theſe defects may be removed by mixing ſtrong earth, or even clay, or rich manures, with ſoils that are too light, in order to make them retain the water, which paſſes too quickly thro' ſuch poor lands.

But as in one caſe, the want of water cauſes an inanition in plants, on the other hand, too much of it cauſes other diſorders: the leaves, tho' green and thick, fall from the trees; the taſteleſs fruit rots before it comes to maturity; and the ſymptoms of this kind of plethory encreaſes in proportion to the decreaſe of the Tranſpiration; the ſhoots remaining green and herbaceous, periſh in the winter; or, at leaſt, the motion of the ſap being too ſlow, the juices become corrupted, and the plants rot. This may be remedied by ditches to carry off the water; or by carrying ſand on land that is too ſtrong, to give it a degree of lightneſs; or by drains made in the land itſelf, by which the ſuperfluous water may run off.

Sect. X. *Of other Soils which require to be prepared.*

Woodlands, Heaths, and Waſtes, are often propoſed to be ſowed; theſe ſeveral kinds of land require different methods to put them into a condition of producing Corn. Some muſt be ſtoned, others drained. We ſhall collect theſe objects into one point of view, when in the next Book we ſpeak of breaking up lands: every thing that relates to the preparation of land will be there found.

ELEMENTS

OF

AGRICULTURE.

BOOK II.

Of Preparations neceſſary to be given Land to obtain a good Crop.

THE Firſt Book, which contains a ſhort, but ſufficient, theory of Agriculture, and compriſes in a ſmall compaſs the fundamental principles of that art, may be uſeful to ſuch as love to give a reaſon for what they do; or to know what ought to be the conſequences of the methods they uſe; whether to rectify them when bad, or put them with confidence into execution, when demonſtrably good and uſeful. But, as it is our intention to write for the many Huſbandmen that content themſelves with the practice of their art, we have compriſed our theory in a ſhort compaſs, to have more room to enlarge on the practical part.

In this Second Book we ſhall treat of the preparations that are to be given land, in order to obtain good crops. Theſe preparations conſiſt in breaking up the land, if it is not in culture; in giving it the neceſſary plowings, if it has long been in bearing; in ſupplying it with manures; in laying it out, or parcelling it in a proper manner; in making a due choice of ſeeds; in giving them the preparations neceſſary to make them ſucceed; and in depoſiting them properly in the earth; and, finally, in extirpating the weeds, which either rob the corn of its nouriſhment, or choak it.

Theſe ſeven heads ſhall be the ſubject of as many chapters.

CHAP. I.

Of Breaking up Lands.

WE here ſpeak of lands which have not been for a long time ſown, and which are intended to be put in a ſtate to receive Wheat or other grain.

Theſe ſorts of land may be divided into four different claſſes; that is to ſay, 1. Woodlands;

lands; 2. Heaths; 3. Lands laid down in Graſs; 4. Such as are too wet. I ſhall treat of theſe ſeveral ſorts of land in as many ſections.

SECT I. *Of Wood-lands.*

Wood was formerly ſo plentiful that they did not take the trouble to fell it. When they were inclined to bring a piece of Wood-land to tillage, they ſet it on fire; and imagined that the aſhes ſupplied the land with a quantity of good manure; but this manner of going to work, did not prevent their being obliged to draw up the ſtumps and to fill up the holes they left; in fact they were obliged to grub up and level the land.

At preſent, wood is ſo ſcarce, that we carefully preſerve that on the ſurface of the ground; grub up the ſtumps, and there is often a great advantage in digging the roots out of the ground.

The holes that are obliged to be made in drawing out the ſtumps and roots give an excellent preparation to the land; inſomuch that when it is levelled, it is only neceſſary to give it one good plowing in autumn. The winter-froſts kill the weeds, and break the clods; ſo that, after a ſecond plowing in the ſpring, theſe lands may be ſown with ſpring-corn, and a good crop expected; for the trees not having impoveriſhed the ſurface, but rather enriched it with their leaves, a conſiderable produce may be hoped for during a number of years.

A ſmall piece of land that had been in Wood yielded me, for above twenty years together, very good crops of Wheat and Oats. It is true this land was particularly proper for Wheat; and that it would have ſooner been impoveriſhed if it had not been ſo good.

Good crops are always to be had from ſtubbed woods, and paſtures newly broke up; theſe advantages are to be ſparingly uſed, for woods and paſtures are always in themſelves of value. Whenever it is found advantageous to raiſe certain trees; Apple-trees in Cyder countries; Walnut-trees for Oil; black, or wild Cherry-trees, for hoops, &c. they ſhould always be on the ſides of paths and ditches; in a word, on the borders of the fields: if they are planted within the land, their number ſhould be ſmall; and they ſhould be lopped, that their ſhade may not hurt the corn.

SECT. II. *Of Heaths, Paſtures, and Meadows.*

Paſtures and Meadows are lands covered with Graſs. Heaths are lands that produce nothing but Broom, Bull-ruſhes, Fern, Heath, Brambles, a few Junipers, and other kinds of Bruſh-wood.

It is beſt to burn this traſh, not only becauſe their aſhes meliorate the earth, but farther, becauſe the fire prevents the roots from ſhooting, and deſtroys almoſt all the ſeeds, which would certainly have ſprouted. It ſometimes alſo kills a number of inſects.

The beſt time to burn heaths is towards the end of the ſummer, when the graſs is dried up; but great care muſt be taken that the fire does not extend itſelf farther than is neceſſary; for above two thouſand acres of Wood-land have at one time been burnt and deſtroyed by the fire communicating from one piece of land to another, occaſioned by the dryneſs of the Graſs.

Theſe precautions conſiſt chiefly in carefully removing all the Graſs, from the ſide on which it is ſuſpected the fire may ſpread, and forming a kind of border to pre-

vent

vent its communication. The Graſs cut from thence ſhould be ſpread on the quarter intended to be burnt, where, after lying a few days to dry, it ſerves to kindle the fire.

Beſides this precaution, calm weather ſhould be choſen, that the wind may not bear the flames to the Wood-lands. Then by kindling the fire next the part to be preſerved, it ſtill gets at a greater diſtance as faſt as it burns the Heath. It muſt be carefully watched, whilſt burning, to prevent accidents; to kindle it afreſh if it ſhould go out; or extinguiſh it, in caſe it ſpreads too far. If, notwithſtanding theſe precautions, the fire ſpreads towards the parts intended to be preſerved, its progreſs may be ſtopped by water, if it is within reach. But the ſureſt way is to make a ditch or trench; for, by throwing the earth of the ditch on the ſide next the fire, it covers the graſs and prevents the fire from ſpreading. I ſhall, on this occaſion remark, that earth is as efficacious, and frequently more ſo than water in ſtopping the progreſs of fire.

When the whole ſurface of the Heath is burnt, the roots of Junipers, Hollies, Box-trees, and other ſhrubs, that would interrupt the plowing, muſt be grubbed up with Mattocks; it is then neceſſary to wait till the earth is moiſtened by the autumnal rains, when it is to be plowed in large furrows with a ſtrong common plow; and, being once more plowed in the ſpring, it may be ſowed with Oats. The ſecond year it ſhould have three good plowings, and the third it will be in a condition to bear a good crop of Wheat. But it muſt be by mere dint of plowing that the Heath, the Dwarf Elder, and ſome other plants can be kept under; for it is very difficult, if not abſolutely impoſſible, to extirpate them. The winter plowings will kill the roots expoſed to the froſt, and the ſummer-plowings ſuch as may be expoſed to the heat of the ſun.

In ſeveral Heath countries, the method of burning differs, and is leſs ſubject to accidents.

1. They cut the large plants, the Thorns, or Broom, and ſell them, or ſpread them in the yards and high-ways to make dung.

2. They take up the ſtumps, and diſpoſe them in heaps in quincunx order, mixed with bruſh-wood.

3. They pare the whole ſpot, raiſing the turf with a large bent inſtrument (Pl. 1. Fig. 2.)

called a Cobbing Hoe; this they term cobbing it. This work raiſes almoſt all the ſmall Broom, and other plants that were left before. We ſhall treat more at large on this ſubject in the next ſection.

M. de Villeſavin breaks up heaths after another manner. When he has taken up the ſhrubs, he traverſes the whole ſpot with a very ſtrong three coultered plow, without a ſhare. This plow, drawn by four or five yoke of oxen, cuts thro' very large roots, and tears up a great number of others. Women, who follow it, pull the roots from the earth, and, tying them up in bundles, they are burnt on the ſpot. When the field is thus cut lengthways, the ſame thing is done croſsways, the women ſtill attending to their work. The field is by this means in a ſhort time, and at a ſmall expence, brought into a condition to receive the common plow. Two plowings are enough for the firſt crop, conſiſting of Oats, and the following year Wheat may be ſown.

SECT. III. *Of untilled Lands, and the Manner of breaking them up.*

Under this head are comprehended Saintfoin, Lucern, Clover, and, in general, all paſtures deſigned to be put in tillage for ſowing. It alſo comprehends certain lands that are only put in tillage every eight or ten years, whether they are too poor to be always in crop, or that the country is not ſufficiently inhabited to till all the land.

With reſpect to paſtures of all kinds, they are generally content with well plowing them. But as lands that have been long at reſt become very hard, it is impoſſible the plow can enter them till they are ſoftened by the autumnal rains.

This plowing, which ſhould be done with a ſtrong common plow, of courſe forms a multitude of large clods, which are broken by the winter-froſts and rains; ſo that when the ſpring is not too wet, a ſecond plowing well-timed brings it into ſufficient tilth to receive Oats; but Wheat muſt not be ſowed, till, by repeated plowings, the land is fine enough to receive that plant, which requires more nouriſhment than Oats.

They are much ſooner brought into order by firſt cutting them with a three-coultreed plow; but it need not be ſo ſtrong as that uſed by M. de Villeſavin in breaking up Heaths. With reſpect to lands that are only tilled every eight or ten years, it is cuſtomary to burn them, that the fire may ſeparate their parts, and the aſhes of the leaves and roots, in ſome meaſure, fertiliſe them. This then is the manner of doing it, or the true method of cobbing lands.

Some ſtrong labourers, having each a curved Hoe with a broad thin iron, raiſe the whole ſurface of the land in Turfs as regularly ſhaped as poſſible *a a a*, (Pl. 1. Fig. 3.) ſo ordering it, that they may be eight or ten inches ſquare, and about three thick.

When the turfs are looſened, ſome women follow, and ſet them one againſt the other ridge-ways, like *b b b* (Pl. 1. Fig. 4.) placing the graſs withinſide.

In fine weather, the air, which affects the turfs on all ſides, dries them in two days, enough to be raiſed into kilns and burnt.

To make theſe kilns a kind of cylindrical tower *a b*, from eighteen to twenty inches diameter *c d*, is raiſed in the work; (Pl. 1.

Fig. 5.) as the wall of this little tower is made with turfs, its thickneſs muſt be determined by the ſize of them; but in raiſing it the graſs-ſide of the turf is laid undermoſt, and on the north-ſide is a door of nine or ten inches wide, to let in the air and kindle the fire.

Over the door they put a piece of wood as thick as one's arm, by way of lintel.

The inſide is then filled with ſmall dry wood, mixed with a little ſtraw, ſome leaves and bruſhwood, gathered on the land; the kiln is then finiſhed, by making with the ſame turf an arch-roof like an oven in which bread is baked. The ſize of theſe kilns is of ſome conſequence; the chief advantage of large kilns is, that they conſume leſs wood. But, 1. The turf and the aſhes muſt be carried a great way. 2. When the kilns are very high, it often happens that by the time the upper part is properly burnt, the lower part is reduced to a brick, and rendered unfit to fertiliſe the land: and if the bottom is in proper order, the top is not enough burnt. 3. As the ſpots in which the kilns are made, are always moſt enriched, the greater number of the kilns there are, the more muſt it be for the good of the land.

So that it is beſt to make them of a moderate ſize, as above ſpecified.

Before the roof is intirely cloſed, the wood in the kiln is kindled: then the door is haſtily cloſed with turf, and the opening *e*, (Pl. 1. Fig. 6.) which was left at the top of the kiln is cloſed alſo, care being taken to to place turfs where the ſmoke comes out too abundantly; after the ſame manner in which the Charcoal-burners manage their kilns; for without this precaution the wood would conſume too faſt, and the earth would not be ſufficiently burnt.

If the kilns were covered with earth, all the ſpaces being too cloſely ſtopped, the fire would be ſtifled; but as turf is uſed, and the graſs always laid undermoſt, there is a ſufficient quantity of air to keep in the fire.

This work is done in the hotteſt months of the year.

When all the kilns are made the field ſeems covered with little hemiſpherical haycocks, ranged in quincunx order, at about ten or twelve feet diſtance one from the other (Pl. 1. Fig. 7.) But the kilns muſt be watched till the earth appears burnt; turfs muſt be put where the fire breaks thro'; ſuch kilns new-raiſed as are thrown down by the force of the fire; and the fire re-kindled where it goes entirely out.

When the earth ſeems to be on fire, the kilns require no farther care; for even rain, which before this time would have been hurtful, will not prevent the clods from burning. So that the kilns may be left to go out of themſelves.

In about twenty-four or twenty-eight hours, when the fire is extinguiſhed, all the clods are reduced to powder; except a few on the outſide, which ſometimes remain quite hollow, becauſe they were not enough expoſed to the action of the fire: and it is on this account we would not recommend too large kilns, becauſe the walls, being proportionably thicker, the outſide earth would not be ſufficiently burnt whilſt that within would be too much ſo; for if it was to be burnt after the manner of bricks, it would not be proper for vegetation. When the kilns are grown cool they wait till the weather is inclinable to rain that the aſhes may not be blown away; they then ſpread the burnt earth as even as poſſible, leaving none on the ſpots where the kilns ſtood, which, nevertheleſs bear finer corn than the reſt of the field. On this account

count they only leave in thoſe ſpots the unburnt turfs.

A ſlight plowing is immediately given to the field to mingle the burnt with the ſuperficial earth; but more dependence is placed on the ſucceeding plowings.

If the firſt plowing can be finiſhed in June, and it is followed by rain, ſome profit may immediately be had from the land by ſowing Millet, Radiſhes, or Turneps; and Rye or Wheat may, nevertheleſs, be ſown the ſucceeding autumn. However, it is beſt not to take this firſt crop as there will be more time to prepare the land properly for Wheat.

Many chuſe rather to ſow Rye than Wheat, becauſe the firſt crops being very ſtrong, Wheat is more apt to be laid than Rye.

Some do not ſpread the burnt earth till juſt before they give the laſt plowing for Wheat, only plowing well the land betwixt the kilns, which they are careful to ſet in a ſtraight line, that the plow may have a free way. But this is a bad method: for, as Wheat is always ſubject to be laid the firſt year on this land, the burnt earth had better be ſpread early, that part of its heat may evaporate, and that the whole land be well plowed: for it is of great ſervice that the burnt earth ſhould be thoroughly mixed with that which is unburnt.

It muſt be allowed that this is a very expenſive way of breaking up lands, becauſe it is all done by manual labour, and conſumes a great deal of wood: but it is very profitable; for by this alone land is brought into better tilth than by many plowings.

I believe, nevertheleſs, that burning lands impoveriſhes them at the long run. The aſhes of the vegetables may give them a temporary fertility; but part of the earth is burnt in brick, and entirely loſes its vegetative quality. I have burnt land in which were no roots, and it did not produce better, nor more grain than what was ſowed in the common way. It is always obſerved that lands, which have been ſeveral times burnt, become very light; which may be attributed to the earth burnt and converted to a brick.

SECT. IV. *Of Lands that are too moiſt.*

We mean not here draining marſhes, nor lands which, being in a bottom, receive the water of the neighbouring fields; nor ſuch as, by retaining the water, are ſeldom in a condition to be plowed.

In this caſe it will be ſufficient to encompaſs the field with a good ditch to receive the water from the neighbouring lands; and even to drain the field intended for plowing, which is eaſily done, if it has ever ſo little ſlope; particularly if it is plowed in ridges, as will in the next chapter be explained: but, if the field has a hollow in the middle, it will be neceſſary to cut a good ditch acroſs, it to carry the water into the ſide-ditch, and even to make little trenches to diſcharge themſelves into the laſt-mentioned ditch. The whole art conſiſts in giving theſe ditches a proper direction ſo as to carry off the water, regard being had to the ſlope of the ground.

When the land is not much out of the level, the Farmers make deep furrows like ditches, with a ſtrong plow, having two ſhoulders or earth-boards ſet very wide, and a long-pointed ſhare, ridged on the upper part. Theſe plows have no Coulters, as not being deſigned to cut a hard earth, but only open, in that already plowed, a deep and wide furrow, to ſerve inſtead of a ſmall ditch.

Theſe deep furrows are called Water Furrows *.

The ſoil being drained, it may be broke up after ſome of the methods mentioned in the preceding ſections; and theſe different ſorts of land will be ready for plowing, according to the nature of them, in ſome of the ways which will in due time be explained.

Many have recommended, for draining lands that are too moiſt, the making ſuch ditches, and putting ſtones at the bottom of them, filling them with the earth that came out. But, excluſive of this work being very expenſive, the fine particles of the earth are carried by the water among the ſtones, and the water no longer finds a paſſage; ſo that I think this method is only practicable in kitchen-gardens; beſides, the ſtones are often obliged to be taken up, and indeed the open ditches we have mentioned ſhould be ſcoured every three years. But theſe open ditches, beſides draining the land, hinder carriages from coming into the fields, and ſpoiling the corn.

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* The French call them Maîtres, or Maſter Furrows.

SECT. V. *Of ſtoning Lands.*

Stoning is proper at breaking up lands; ſomething therefore muſt be ſaid on this ſubject.

It muſt not be imagined that ſtones are always enemies to vegetation. I know fields, and we have even ſome of that kind, which bear fine Wheat, tho' nothing is to be ſeen but ſtones, eſpecially when freſh-plowed, and a ſhower of rain has fallen to waſh the ſtones. Theſe ſtones are of a calcareous kind; but there are others of the flint kind, which do not leſſen the fertility of land.

It is nevertheleſs always proper to remove the large ſtones which incommode the plow. But ſuch as are no bigger than the fiſt, are of benefit to clayey ſoils; they are thereby eaſier tilled, and leſs retentive of water.

In the province we live in, they carefully ſtone Saffron grounds, leaving none bigger than a nutmeg; as theſe are dug to a great depth, and lands planted with Saffron are ſeldom clayey, this ſtoning is of great advantage to them.

When they ſtone gardens, they make trenches in the walks, and bury the ſtones in them; by this means ſaving the carriage and making the walks drier. But this is not practicable in large fields.

They make fences of them; or, what is much better, they lay them on the highways, when they are not wanted for building.

It is neceſſary alſo, in ſtoning land, to remove the rocks that break the plows, or at leaſt to take away ſo much of them as will leave room for a bed of earth ſufficient to nouriſh the corn that is to be ſown.

SECT. VI. *The Concluſion.*

It is certainly very beneficial to make ſuch lands of value as are not ſo, or to break up barren lands. The produce of Heaths and Paſtures being very ſmall, it is a ſure gain to put them in a ſtate of producing good corn. But this amendment is not made without great trouble and expence; it muſt not, therefore, be done but on land that is naturally ſo good as to reimburſe the expences; I would alſo recommend it to good oeconomiſts not to break up more land than they can keep in good tilth. Every body is now breaking up land: I ſee proprietors who expect miracles from the purchaſe of a few yokes of oxen to plow up their waſtes: but what is the conſequence? Theſe half-tilled lands, deſtitute of manure, produce but little; the proprietor is tired of large expences and ſmall gains: as he cannot manage his large undertaking, the weeds get a-head, and the land falls again to waſte; but this would not have been the caſe, if no more land had been broke up than what could have been properly kept in order. Thus, the beſt advice I can give to good oeconomiſts, is firſt to get their plowed lands in proper order, before they think of breaking up waſtes.

We ſhall, in the next chapter, make it evident, that moſt lands now in tillage are badly cultivated; and that it is neceſſary to bring theſe into order, before we think of the waſtes.

CHAP. II.

Of Tillage.

WE have already made it appear, that the more the particles of the earth are divided, by ſo much the more are the internal pores encreaſed; that the more the ſurfaces

faces of the particles are enlarged, with ſo much greater eaſe do the roots extend; that the better condition the earth is put in to ſupply plants with food, ſo much the more fruitful muſt it of courſe be rendered.

It may be added that, by this diviſion, the introduction of the water among the earthy particles is facilitated, over the ſurfaces of which it would otherwiſe paſs without penetrating them. This diviſion alſo cauſes the admiſſion of the air and ſun-beams, two agents very neceſſary to vegetation.

This diviſion may be two ſeveral ways effected: by cauſing the particles to ferment naturally, which is the effect produced by a mixture of dung with earth; or by mechanically breaking the particles: this is the effect of tillage, and, of courſe, the ſubject to be treated of in this chapter: what regards manures is reſerved for another.

SECT. I. *Advantages of Tillage.*

It is often more profitable to encreaſe the fertility of land by Tillage than by Dung: 1. Becauſe a certain quantity of dung only can be got, as the produce of twenty acres is ſcarcely ſufficient for five or ſix: but the particles of earth may, on the other hand, be divided and ſubdivided without end. The aſſiſtance derived from dung is then limited; but there is no knowing the end of the benefits accruing from tillage.

2. Few plants raiſed in dung have the fine flavour of ſuch as are raiſed in good earth, but moderately mended. This difference is conſtantly perceived in our kitchen gardens, and other gardens. Pulſe and fruit is ſeldom ſo good near great towns, where dung is plentiful, as in country gardens, where they cannot be prodigal of their dung. In lands very much dunged * the corn has a great deal of bran and but little flour. It is alſo more difficult to preſerve, and nice horſes will not eat oats gathered from fields ſowed with Poudrette †. But nothing is ſo ſtriking as the different

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* Mr. Tull even hints, that dung gives noxious, or, at leaſt, unſalutary qualities to plants: but the reaſons he gives in ſupport of his opinion, do not ſeem admiſſible. For inſtance, when he ſays, that venomous animals are more frequently found in dung than elſewhere, and mentions a Toad as an example: Toads, in fact, are not venomous; and, if they were, it is well known that Wolf's-bane may, without injuring it, grow cloſe to a very wholeſome plant. There is, moreover, great room to think that a plant, by nature poiſonous, would be far leſs ſo raiſed in earth much dunged, than if it had grown in a dry and barren ſoil; for the ſame reaſon that Celery receives a finer flavour and more virtue from poor land than that which is much dunged.

† Poudrette is Human Ordure expoſed for a long time to the air, and by that means reduced to powder.

different quality of Wine produced from an undunged Vine, and that made from the grape of one much dunged.

3. Dung, which may operate by fermentation, makes in fact an internal diviſion of the parts, which muſt be of great uſe as well as the ſubſtance which it yields: but the plow not only divides the particles, but changes their places and turns over the ſoil; the part which had been expoſed to the influence of the air and dews, takes the place of another part, which from within the earth is brought to the ſurface. Whence it follows, that ground well plowed is not impoveriſhed by weeds: that the raiſed earth is impregnated with the water of rains and dews, and penetrated by the ſun-beams; all which are highly neceſſary to make it fruitful, as is evident from a great number of experiments.

4. Dung attracts inſects, and inſects deſtroy plants. Experience tells us, that when we dung lands on which trees are to be planted, their roots are ſubject to be hurt by inſects; and this is one of the principal reaſons why the Floriſts baniſh dung from their gardens. The great white Worms and the Mole crickets often make great havock in the beds; I have ſeen meadows en-

tirely naked, on account of the roots of the graſs having been eat by the white Worms.

It may be farther added, that dunghills contain many ſeeds which produce weeds without number.

5. It muſt be allowed, that dung is equally ſerviceable to light and ſtrong lands; but the ſame may be ſaid of tillage.

We have already ſaid, that too ſtrong land is that in which the parts are ſo compact as with difficulty to admit the roots penetrating. If the roots cannot freely extend in the earth, they cannot imbibe the food of plants, which will of courſe remain impoveriſhed and ſickly. But when, by dint of proper tillage, theſe ſoils are broke; when their particles are ſo ſeparated one from the other, that the roots will be at full liberty to extend and traverſe all theſe little ſpaces, they will be in a condition to ſupply the plants with the nouriſhment they require; and it will ſoon be perceived in their encreaſed growth.

Tillage is equally ſerviceable to light lands, but on a different account; we ſhall in due time mention it. Nevertheleſs, it muſt be admitted, that ſtrong lands require more frequent tillage than light lands.

However profitable dung may be when to be got in plenty, and tho' its defects might in part be cured, it does not at all leſſen the great advantages proceeding from frequent tillage.

It is on this account that three or four plowings are beſtowed on lands intended for Wheat. Some Farmers have even ventured to double the number of plowings in fields which they could not dung, and they have born better crops than ſuch as had been well dunged. To give three plowings extraordinary would coſt only eighteen ſhillings; on the contrary, in many places a ſufficiency of dung would coſt three pounds. In this manner does bad management injure.

Some alteration then ſhould be made in the tillage of lands. The plowings given for Wheat in the provinces of this kingdom, do not ſufficiently reduce ſtrong lands. They only form in ſuch ſoils great clods with large cavities between them; this is by no means the proper way to ſupply plants with food. After what has already been ſaid, this muſt be admitted. It is then abſolutely neceſſary to break the clods, and reduce them by tillage into ſmall particles. Then the ſtrong land, being made lighter, is in a ſtate proper to receive plants; and to prevent its returning to its firſt ſtate, it is only neceſſary to hinder its being poached by cattle or carriages, to take care to dreſs it with frequent plowings in proper weather, as will be explained in the courſe of this work.

But what makes it evident how uſeful it is to facilitate the paſſage of the water, the ſun-beams and the roots, in ſtrong ſoils, is, that they are ſometimes rendered more fruitful by mixing ſand with them inſtead of dung. Sand gives no nutrition; but, by preventing the particles from uniting too cloſely, it cauſes the good effects we wiſh for.

Light lands do not ſeem to require quite ſo much tillage as ſtrong lands; and this is the fact; but there is no danger of impoveriſhing theſe ſoils by frequently turning them, and expoſing their particles to the ſun. We have already remarked, in the preceding chapter, that the ſun takes nothing from the earth but moiſture, which the firſt rain returns, and not any of the juices proper for the nouriſhment of plants. Experience convinces us that light ſoils are improved by tillage, either as by grinding and ſtirring their particles, they are in a better ſtate to receive the moiſture of the rains and dews, to be benefited by the influences of the air, or penetrated by the ſun-beams; or, as the internal pores are better adapted to the extenſion of the roots; or, finally, becauſe frequent plowings deſtroy the weeds, which multiply prodigiouſly in certain ſoils both light and ſtrong, particularly when they have been ſpread with half rotted dung.

To prove by an experiment what we have ſaid with regard to light ſoils, let us ſuppoſe that a ſlight plowing only is given to half a field, and that the other half is thoroughly plowed ſeveral times. If, ſome time after, in dry weather, the whole field is plowed anew, ſo that the furrows may croſs thoſe of the old fallow, the earth of that part of the field which was well plowed will be viſibly of a darker colour than that which was only ſlightly tilled, which evidences the advantage the field has received from the plowings.

A Farmer, under the Preſident de Monteſquieu, had in his farm near Clairac, a plentiful crop of Maiz, when the crops of all his neighbours were very poor. The Preſident aſking him, in what manner he managed to have this ſingular advantage, the Farmer told him he had plowed his land eleven times betwixt ſeed-time and harveſt.

By means of this frequent tillage his land had reaped the benefit of all the rains, dews, fogs, &c. whilſt his neighbours land had not been benefited, owing to a kind of dry and hard cruſt, the conſequence of want of tillage.

Meſſieurs Delu and France, by frequent tillage, have good crops from fields which before, by being badly managed, bore but very indifferently. It is partly owing to their being well tilled that lands always bear more plentiful crops in populous provinces than in ſuch as are thinly inhabited.

To deny the good effects of Tillage, one muſt know nothing of Huſbandry. Nevertheleſs, tell a Countryman that his lands are not ſufficiently plowed; and, to juſtify his lazineſs, he will reply, that by frequently removing the earth the ſun exhauſts it's ſubſtance. We have already anſwered this futile objection; but, to take away all pretence of lazineſs, and, at the ſame time, demonſtrate, that lands well tilled are not even exhauſted by their crops, it is ſufficient to obſerve, that the ſame good lands, properly tilled, yield us as plentiful crops as our anceſtors formerly had from them.

This principle ought generally to be adopted in Huſbandry, That the money laid out to give land proper tillage is repaid with intereſt at harveſt. I knew a Farmer who, being alſo a Wheelwright, was greatly hurried at ſeed-time; he ſowed his corn on lands that had been but twice plowed; but he ſaw the difference at harveſt; for his crop was but very indifferent. If, in a country where it is cuſtomary to give Wheat-lands three plowings, the Farmers who have ſtrong teams, finding their work forward, give four plowings to a part of their lands; they are very ſenſible this plowing will be well paid for at harveſt. In like manner, it is cuſtomary for our Farmers in Beauſſe to beſtow only one plowing on Oats; but every Huſbandman knows that ſpring-corn lands bear much better crops when they have a firſt plowing immediately after harveſt, and a ſecond given before they are ſowed.

In 1759, M. Delu gave three plowings to part of his lands deſigned for Oats; and, tho' the year was very dry and unfavourable to ſoft corn, he had in theſe lands a full crop; his Oats ſtood well till they were ripe, and tnrned out excellent corn.

He alſo cauſed five plowings to be given to a piece of land intended for Wheat, but it was not dunged: when harveſt-time came, the Wheat of this field was grown higher, and looked finer than in any of the adjoining fields which had been dunged and tilled after the manner uſed in that country. Nothing better proves the truth of the principles we have endeavoured to enforce in all our works, relative to the advantages of Tillage.

As theſe facts are proved by many experiments, and well known to be true, why then do not the Farmers encreaſe the number of their plowings? Several things prevent them from doing it: 1. Many Farmers preſerve their ſtubble to feed their Sheep; if they turned over this ſtubble immediately after harveſt, they would loſe this advantage. This reaſon, which may hold good in well-cultivated provinces, can have no force in ſuch farms as have Heaths and Paſture wherein to turn their flocks. 2. Some years are ſo dry, or ſo wet, as to retard the works, as much time elapſes before it is poſſible to plow; in this caſe the beſt Huſbandmen can give but three plowings to their Wheat-lands.

Such as are ſenſible of the advantages of proper Tillage, give four plowings in favourable

able ſeaſons; and they are careful to plow thoſe lands firſt that moſt want it; that is to ſay, ſuch as are very weedy; ſuch as harden by the heat; ſuch as having been traverſed by carriages, or plowed at improper times, are full of clods; for we muſt not alone increaſe the plowings, but give them at proper times. A ſtrong and heavy ſoil, as a ſtiff clay, would be more hurt than brought into tilth by being plowed wet; inſtead of its particles being broke and divided, it would be kneaded and turned into great clods, which being baked and hardened by the ſun, would make it very difficult to plow.

If we plow with a view to deſtroy weeds, it is proper to ſtay till the ſeeds of them are come up, and the fallow looks green before we give the land a ſecond plowing. The plow then buries the weeds, which enrich the land inſtead of impoveriſhing it. But if the plowings were given one immediately after the other, the weeds which the firſt plowing had buried, would be again turned up, and only thrive the better for having been moved. There is no better way of deſtroying weeds than by plowing in the hot, dry, ſummer weather.

Some ſoils cannot be plowed too deep: where the earth under the ſurface is good, it ſerves inſtead of manure, and replaces that which had been long in uſe. In others, on the contrary, ſeveral crops would be loſt by plowing too deep.

An attention to theſe matters diſtinguiſhes the thinking and rational Farmer from the Clown, who is content to drive his plow. Unhappily we have too many of this laſt ſort, who, accuſtomed to work, but incapble of reflection, blindly follow the path laid down by their fathers; and this is the reaſon that ſo much fine land that would bear good crops, either lies waſte or ſcarcely returns its ſeed. We ſhall convince our readers that the methods of making an eſtate profitable are neither difficult nor ſublime, but plain and ſimple; but we muſt firſt dwell a little on the proper way of plowing.

SECT. II. *Of the different Ways of Plowing Land.*

According to the nature of ſoils, and the cuſtoms of the ſeveral provinces, plows differing conſiderably one from the other are uſed: they ſhall be treated of in a ſeparate chapter. Theſe plows are drawn by various animals, Aſſes, Mules, Horſes, and Oxen; and each of theſe animals have peculiar qualities.

The Aſs is an animal very common in all the provinces; it is of ſmall value, coſts little keeping, and is ſubject to few diſorders: but its feet, being ſmall, are apt to ſink into ſoft lands; its motion is ſlow; and for drawing it is not a fourth part ſo ſtrong as a horſe. So that this animal can only be of uſe in light or ſandy ſoils.

Mules, in proportion to their ſize, are as ſtrong as Horſes: they have ſpeed, are reaſonably kept, and but little ſubject to diſorders; but, as their feet are ſmall, they ſink into fat and greaſy ſoils. The She-Mules are moſt commonly uſed, becauſe they are ſtronger than the gelt He-Mules; and it is neceſſary to perform this operation on them, or they are with difficulty made gentle; but it impairs their ſtrength.

Horſes are ſtrong, walk light, and having broad feet, eaſily draw them out of ſoft land: moſt of them are docile, and even become acquainted with their work; but of all animals uſed in tillage this is moſt expenſive in keeping; they live long, and are nice in their food, are ſubject to many diſorders; and, finally, in common with the Aſs and the Mule, are of no uſe when by any accident crippled.

The Ox, being ſtronger than any of the animals I have mentioned, is proper for deep plowings: he requires neither dreſſing nor currying; his food is cheap; his harneſs ſo ſimple that it coſts ſcarcely any thing; he hardly ever ails any thing unleſs over-worked; he lives to a pretty good age; and when either thro' age, or on account of any accident, he becomes incapable of working at the plow, he is fatted, and fetches more money than if he had been bought younger.

It would be proper for a ſubſtantial Farmer to have ſome yokes of Oxen to winter-fallow his land, to break up his lays, and do other heavy works; but he ſhould alſo have a good team of Horſes to make his laſt plowings, for Oxen are but ſlow in pace.

In breeding countries, the Farmers ſcarcely uſe any thing but Cows for plowing; but they put them to it only a part of the day, particularly when they are in calf, or ſuckling.

It will be proper, in this place, to ſay ſomething of the uſe of theſe different animals. To return to plowing.

The tillage of land conſiſts, as we have before ſaid, in turning it upſide down, or of cauſing the lower earth to be brought to the ſurface, to receive the influence of the air, whilſt that which was uppermoſt, and had enjoyed that advantage, is turned down with the weeds it had produced, which, by rotting, contribute to enrich it. This work cannot be done without changing its poſition either by manual labour with the hoe, ſpade, &c. or by uſing the ſtrength of animals put to plows. The Tillage by the plow is more expeditiouſly done than by hand; but it is not ſo effectual, becauſe it does not ſtir the ground ſo deep. Therefore, in certain diſtricts, where they ſpare no pains to till the lands well, they give it every five or ſix years a compleat dreſſing, by breaking the ſoil with ſpades, hoes, and mattocks.

The number of plowings, and the manner of doing them, varies in different provinces according to the different nature of the land; but all have the ſame end, to deſtroy weeds, break and raiſe the earth, and bring it into proper tilth for ſowing.

In ſoils that do not retain the water, it is beſt to plow the land flat that no ground may be loſt; but, if they retain the water, they muſt be plowed in ridges, or, at leaſt, in broad lands or ſtitches, according to the ſlope neceſſary to be given to carry off the waters; ſo that, according to the nature and ſituation of the land both theſe ways of plowing are ſometimes practiſed in the ſame farm. This then is the method in which they plow the the land flat.

To be able to plow a piece of land properly, it is neceſſary that the ſurface ſhould be tolerably even; that is to ſay, that there be no holes or bottoms in it. If there are any holes, they ſhould be filled up, and the bottoms ſhould be raiſed as much as poſſible.

There are two ways of plowing, according to the plow that is made uſe of, with thoſe called Shifting Ear-Plows, with an uniform ſhare reſembling the blade of a lance, and a little moveable earth-board called the Ear, which may be placed either on the right or left ſide of the plow, the Huſbandman can diſpoſe as he pleaſes of the earth looſened by the ſhare, and turn it either to the right or left, according to the ſide he fixes the ear on.

With theſe plows, they begin their work on one ſide the field, and finiſh it on the other. Let us, for inſtance, ſuppoſe that the field *a b c d* (Pl. 1. Fig. 8.) is to be plowed, they draw the firſt furrow from *a* to *d*, fixing the ear, or earth-board, on the right ſide, ſo that the earth is turned over on the adjoining land, at the ſpot noted by the pricked line 1, 1, and by this means the furrow *a d* is opened; being come to *d*, the ear, or moveable earth-board is fixed on the left ſide, and the poſition of the coulter altered; and in making the furrow *e f*, the furrow *a d* is filled with the earth thrown out of *e f*, the earth being turned on the ſpot noted by the pricked line 2, 2: being come to *f*, the ear, or earth-board is fixed on the right ſide again to make the furrow *g h*, the earth of which is thrown into the furrow *e f*; and, by continuing this method to the end of the field, there remains an open furrow, becauſe it could not be filled but by encroaching on the adjoining land.

It is proper to remark, that if the ſecond plowing is not made acroſs the land, the furrow *b c* ſerves by way of trench, and is filled in making the firſt furrow *i k*. But to ſtir the land better, croſs-plowing is often preferred; they then make the firſt furrow from *a* to *b*, and finiſh their work by leaving an open furrow at *d c*. This croſs-plowing cannot always be made. If the piece is very narrow,

much

much time would be loſt in turning the plow; and if it abutted on a Vineyard, or piece of ſown land, much damage might be done. In this caſe, they either make the ſecond plowing in the ſame direction with the firſt, or elſe obliquely cut the furrows of the firſt plowing; for inſtance, in the direction *l m*.

The other kind of plow, having a ſhare with only one wing and an ear, or earth-board, fixed on the right ſide, is called an Earth-board Plow; it works only one way, turning the land always on the ſame ſide. In uſing it, they plow ſucceſſively the two ſides of the piece, or take it in portions as follows:

Suppoſe the field *a b c d* (Pl. 1. Fig. 9.) is to be plowed with this plow, a furrow is drawn from *a* to *e*, and as the earth-board is fixed on the right ſide of the Plowman, the earth is turned over on the ſpot marked by the pricked line 1, 1, as faſt as the furrow *a c* is forming: the earth-board, being always of the ſame ſide of the plow, it is evident that if the Plowman went from *e* to *f*, he would turn the earth over on the pricked line 2, 2, and the furrow *c a* would not be filled: but the Plowman takes his plow to *d*;

and drawing the furrow *d b*, he turns the earth on the ſpot marked with the pricked line 3, 3; he then brings his plow to *f*, and making the furrow *f e*, he fills the furrow *a e*, by turning the earth of the furrow *f e* into the pricked line 2, 2.

It is evident then, that, by continuing to plow the field alternately in the part *a g c h*, and in the other part *b g d b*, and making all the furrows of the firſt part like *a c*, and all thoſe of the ſecond like *d b*, the whole field will be plowed, ſo that there will only remain in the middle a large trench formed of the two furrows *g b*.

In uſing this kind of plow it is not cuſtomary to begin at the two ſides and finiſh in the middle, unleſs it be in very ſmall plots. Large fields are plowed in ſtitches. To do this, they begin by drawing a furrow from *a* to *b* (Pl. 1. Fig. 10.) then in returning they draw another from *c* to *d*, and the fallow riſes betwixt theſe two furrows: then they fill the furrow *a b* by opening the furrow *e f*, and the furrow *c d* is filled by opening *g b*: this work is continued till the ſtitch is of a proper breadth; and making, after the ſame manner another ſtitch, the furrows of the two ſtitches muſt meet, having betwixt

them

them a large trench, which is filled up by the two firſt furrows of the ſecond plowing. It is evident that to make broad lands *i* (Pl. 2. Fig. 1.) ſix, or a greater number of furrows, are made from *a* to *b*, and a like number from *c* to *d*, and that theſe broad lands, or large ſtitches, are divided by a large trench *k*. If in ſoils more apt to hold water, the ſtitches *l* (Fig. 1.) are to be made narrower, only three or four furrows are made from *a* to *b*, and as many from *c* to *d*, ſo that the ſtitches conſiſt only of ſix or eight furrows *.

If in ſoils very ſubject to be wet and poachy, very narrow ſtitches *m* (Fig. 3.) called ridges are to be made, only one furrow is drawn from *a* to *b*, and another from *c* to *d*; ſo that there is alternately a ridge of fallow, and a furrow or trench. It depends alſo on the ſlight of the Plowman to raiſe theſe ridges higher in the middle than on the ſides, by taking a greater or leſs hold. This matter ſhall be more fully diſcuſſed hereafter. In both theſe methods of plowing the earth, which the plow pierces to form a trench, is turned into the furrow already formed to fill it with the ſtirred earth of which the fallow conſiſts; and this done ſucceſſively over the whole extent of the land, ſo that the laſt furrow only remains empty for want of earth to fill it; for it has been mentioned, that the earth of the firſt furrow, when it is made at the edge of the field, is borne on the adjoining land, by being turned upſide down, and to make room for the earth of the other furrows; and this earth depoſited on the adjacent land is deficient in the laſt furrow of the field, where this deficiency forms a trench to be filled by the next plowing.

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* Land is often laid flat with this plow, and when the field is ſowed and harrowed, furrows are made at equal diſtances to form ſtitches. But this way is not ſo good as that above deſcribed, becauſe the ſtitches being flat and bounded by a little riſe of earth, the water has not ſo eaſy a deſcent.

The firſt plowing is called Turning the Fallow, that is, making the fallow, which conſiſts only of plowed land.

This firſt plowing, by which the Oat-ſtubbles are turned, is made betwixt the months of January and June. In ſome countries they do not begin till April. But it is every where finiſhed by St. John's Day. As the earth has not been ſtirred for fourteen months, this plowing is more laborious than the reſt: on this account many Farmers do it very ſlightly to ſave their horſes; but ſuch as have good teams will do well to plow as deep as the ſoil will permit; if, inſtead of ſaving the graſs for the cattle, this plowing was given before winter, as it commonly raiſes large clods, on account of the earth's not having been lately ſtirred, the winter froſts, which penetrate theſe clods, would mellow the land much. For this reaſon the plowings given in or before winter cannot be too deep; the more the land is raiſed the better hold the froſt takes of the earth. But the Farmers plow their ſtubbles too late, in order to keep feed for their cattle.

The ſecond plowing, which is called the Twifallowing, begins when the fallows are turned, and ends in September. It is begun at the furrow which finiſhed the laſt plowing, which, ſerving by way of trench, is filled up.

In flat plowing the furrows are, as we have already remarked, ſucceſſively made, till the earth on the other ſide of the field, which was laid on the adjacent land, is turned back again.

In ſtitch-plowing, the middle of each ſtitch is in the part which was before the trench, and the trench is formed in the middle of each old ſtitch. Finally, in ridge-plowing, the ridges of the laſt plowing are ſplit to fill up the trenches, and the new trenches are formed where the ridges before ſtood; but ridges are ſeldom made till the laſt plowing, when the ſeeds are to be covered.

It is proper to obſerve, that in theſe plowings, one of the horſes always goes in the furrow that the ſhare is filling, whilſt the other treads on the unplowed land; the ſhare follows betwixt the two horſes, and the Plowman walks in the furrow that is making, by which means the fallow eſcapes being trampled on. It is neceſſary to underſtand well theſe little remarks, the better to comprehend what will hereafter be ſaid, when we treat of the different plows, and deſcribe the method of forming ſtitches for the new Huſbandry.

The third plowing, in ſome places called the laſt plowing, prepares the fallow for ſowing, and in this caſe the ſeed is harrowed in.

In ſome provinces, the third plowing, called the Second Twifallowing or Trifallowing, is exactly like the firſt, except that the earth, being more looſened, it is eaſier done. In this caſe they ſow on the fallow, and bury the ſeed with the plow: this makes a fourth, or laſt plowing, which is done like the reſt; but it ſhould be light and not run deep, that the ſeed not being buried too deep, may ſprout from the earth. It is neceſſary to underſtand theſe two methods of ſowing and covering the ſeed, either with the harrow or plow; the laſt method is called Sowing under Furrow. Without this introductory knowledge, it would be impoſſible to have a proper idea of the advantages of the drill, of which we ſhall hereafter treat.

With reſpect to ſpring-corn, it is cuſtomary to give only two plowings to Barley-lands, and but one to thoſe deſigned for Oats. When two plowings are given, the firſt, which is called the Winter-fallowing, is given directly after Wheat-ſeed time; and the ſecond immediately before Barley-ſeed time. When only one plowing is beſtowed, they do it in January or February.

Many Farmers pretend that to encreaſe the plowings for ſpring-corn would be dangerous. This is only a pretence to ſave labour: we could diſprove it by an amazing number of experiments; but it is ſufficient to refer to thoſe we have related, by which it may be ſeen that Oats which have had two plowings, or even three, have ſucceeded much better than ſuch as have been ſown after a ſingle plowing. Why were the Barleys ſown in 1709, ſo exceeding fine, unleſs it was becauſe

cauſe they were ſown on lands which having been prepared for Wheat, had received three or four plowings, beſides the fifth at putting the Barley into the ground? We do not recommend the like practice every year; but believe it proper to give two plowings to land intended for Oats.

The methods of plowing differ, not only according to the ſtate of lands, as they do or do not retain the water, but alſo according to the nature of them; that is ſay, as they are light or ſtrong, and produce little or much Graſs.

There are poor and light lands which have no depth; that is to ſay, white virgin Earth, Chalk, or even a Rock is found very near the ſurface. Great crops are never to be expected from theſe lands. Nevertheleſs, in populous counties they are cultivated. Some ſome kind of depth † is by degrees given by cutting into the virgin Earth or Chalk, and this with the help of dung aſſiſts them a little: theſe lands are plowed cheap, when the ſurface of them only is ſcratched with a wooden inſtrument pointed with iron and a little Horſe, or even an Aſs, which ſerves well enough to draw theſe ſort of plows, which have no wheels; but then the crop is but trifling.

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† In the Journal Economique, a kind of raker is recommended to cut chalky bottoms.

There are excellent Wheat-lands, which conſiſt only of a bed of ſoil about four inches thick, under which we meet with a red barren earth. As theſe lands ſuck up the rain as faſt as it falls, they are plowed flat, and great care taken that the plow does not pierce the red earth, which would leſſen the next crop; unleſs, by dint of dunging, the earth was brought to its former ſtate.

It appears to me very probable, that in a length of time, and by proper tillage, the red earth mixed with the upper ſtratum would become good; but Farmers will not venture the loſs of ſeveral crops: beſides, it coſts them leſs to plow only the ſurface of the land than if they went deeper.

Theſe lands are tilled with thoſe called Shifting Ear-plows.

When lands are ſtiff, ſuch as ſtrong loams, plows more ſubſtantial than thoſe we have mentioned are made uſe of. The ſhare of theſe plows is almoſt as broad again as the ſhare of the ſhifting Ear-plow. Theſe great plows have not the part called the Ear; but inſtead of it a piece of wood called the Earth-board firmly fixed to the right ſide of the plow. Theſe are on this account called Earth-board Plows.

Some of theſe plows do not cut deep furrows. As their ſhare is very broad, they raiſe a great breadth of earth, which they turn over on one ſide almoſt without breaking. It is true, an acre is ſooner turned with theſe plows than a ſhifting Ear-plow; but it requires four ſtrong horſes to draw them, when two are ſufficient for the other.

As by this way of plowing, a lump of earth or large turfs are turned over, I cannot think the land is ſo well ſtirred as it is by the ſhifting ear-plow.

The breadth of the turf which the plow raiſes, gives the lazy Huſbandman an opportunity of making ſlovenly work, which we will explain.

Suppoſe a field, like A B C D, (Pl. 2. Fig. 4.) is to be plowed. The workman begins a furrow at A, and turns the earth to the ſide E. He then goes as we have already ſaid and begins another furrow at C; and turns over the earth to F. When he comes to D, he proceeds to make another furrow by the ſide of A; but, inſtead of beginning at G to turn the earth into the furrow, he begins at H, and turns over the earth on the unplowed land G, which is cloſe to it as may be ſeen at I; there then remains a trench H L. He next makes another furrow from M to N, and turns the earth on a ſtripe of unplowed land.

And by continuing this practice to the end, all the land ſeems plowed in deep furrows, tho' in fact but half of it is plowed. Such as follow this practice, having only the killing of weeds in view, think they have done great matters, becauſe the weeds on the unplowed land are choaked by the earth turned upon them: but more is to be done beſides killing the weeds; the earth ſhould be ſtirred and broke, and the under-earth expoſed to the atmoſphere; which this way of plowing cannot effect. It is true that, at the ſecond plowing, furrows are made where the balks ſtood, which are turned into the old furrows. But what is the conſequence? They think they have made two plowings, when it is in fact but one, ſince the whole land has been ſtirred and turned over but once.

When lands are very ſtiff and clayey, they are tilled with the ſame kind of plows; but their ſhare is not ſo broad, and they pierce the ground more. There muſt be, therefore, four horſes to draw them, tho', in making each furrow, a ſmaller breadth of earth is moved.

We have remarked, that lands which are not retentive of water, are plowed flat, and that clayey lands are plowed in ſtitches or ridges, as they are more or leſs apt to retain the water. But ſtitches and ridges are, for the moſt part, to be preferred, that leſs land may be loſt; for the furrows produce nothing.

It is unneceſſary to remark that, as theſe ridges are only made to drain off the water, they muſt have their direction according to the ſlope of the field, that it may the ſooner run off.

To lay a ſandy ſoil into ridges, the land is ſometimes plowed flat, ſowed, and the grain harrowed in; then, at two feet diſtance from each other, deep furrows are drawn by an inſtrument called a Trenching Plow. It has no coulter, but a long narrow ſhare, with two great earth-boards, very much ſpread on each ſide the plow-handle, and ſloped at bottom, ſo that the plow with its point forms a kind of wedge, which opens the earth; the middle of the earth-boards turns it over on each ſide, and the widened extremity of them, which is ſloped, flattens the earth; by which means ſharp-raiſed ridges are very regularly formed. But this way of plowing is only practicable in ſandy ſoils; this kind of plow would knead a clayey ſoil, and the ſhare would with difficulty find a paſſage. It is proper, in general, to obſerve, that plows which only open the ground like a wedge, are not ſo good as ſuch as have ſharp ſhares; in ſtoney lands they are, however, of neceſſity uſed.

SECT. III. *Of the different Inſtruments uſed in Tillage.*

We have already remarked, that all lands are not to be tilled the ſame way; therefore a plow that may be fit for one ſoil may be very unfit for another.

If the lands in Beauſſe were to be tilled with the plows uſed in very light lands, without coulters or wheels, the ground would be ſcarcely ſcratched. In like manner, if very ſtiff and clayey ſoils were to be tilled with the ſmall plows uſed in Beauſſe, they would not ſtand to their work; or, at beſt, would make a very ſlight tillage of no uſe. The Huſbandmen of Beauſſe have alſo earth-board plows, to break up Saintfoin, Lucerne, and plow fields where roads have been made in the winter; for the land is here ſometimes ſo hardened, that the ſhifting-ear plows would break ſooner than open it.

Deep ſoils ſhould be plowed as deep as poſſible; but for this purpoſe ſtrong plows are neceſſary, with broadiſh ground-wriſts and ſhares; for if theſe parts were narrow, as a furrow is to be opened cloſe to that which was before made, and as the earth has great reſiſtance, the plow would be puſhed into the trench; but when the ſhare is broadiſh, the plow cuts the earth farther from the furrow, and opens it without ſlipping into the laſt-made trench.

The ſpade is an excellent inſtrument for tillage; it ſtirs the earth ten or twelve inches deep, and this earth is turned over; but this work is tedious, laborious, and expenſive, ſo that it can only be practiſed in gardens, or in certain diſtricts where there are many inhabitants and but little land. The plow is much more expeditious, but it ſeldom ſtirs the earth deep enough, and often turns it over in a lump without breaking the clods: the coulter cuts the turf vertically: the ſhare which follows it, cuts the earth horizontally: and the earth-board, or ear, turns it over in a piece on one ſide. The inconvenience of theſe clods is in part remedied by uſing narrow ſhares, which make a fine tillage, and break the earth more than the broad ſhares.

It thence follows that, at the ſecond plowing, the looſe earth only is to be ſtirred, inſtead of clods and turfs, which, having taken root ſince the laſt plowing, are almoſt as hard to ſeparate as if the land had not been at all plowed.

Many Huſbandmen pretend that their plows cut the land ten, twelve, or fourteen inches deep: but it ſeems to me impoſſible for any plow whatever to do it. Our Plowmen think they have cut ſix or eight inches deep, becauſe they meaſure from the top of the ſtirred earth to the bottom of the furrow; but this meaſure ſhould only be taken from the ſurface of the unplowed land to the bottom of the furrow.

When a piece of uncultivated land, or a field that has not been plowed of a long time, is to be brought into tilth, it ſhould be very moiſt, eſpecially if it is ſtiff land; otherwiſe it would be ſo hard, that neither the coulter nor ſhare could cut it, nor the earth-board turn it over. By breaking theſe lands up before the winter comes on, the froſt moulders the clods which are of courſe formed. But when theſe lands are in tilth, they muſt never be plowed wet; for then the trampling of the horſes, and even the earth-board, kneads ſtiff land, almoſt as Potter's earth is prepared when they make earthenware; by this means the land is rather hurt than benefited.

The putting the horſes one before the other has been recommended in plowing ſoft lands, that going all in the ſame furrow, they might not knead the earth; but the preſſure of the earth-board is not by this means removed.

When land is in good tilth, it may be plowed in dry weather; but the beſt time is when the earth is a little moiſtened with rain.

It is true that in deep plowing, as a large plow is to be drawn, and a larger maſs of earth moved, it will be neceſſary to uſe three horſes inſtead of two, and four inſtead of three; but if the earth under the ſurface is good, this encreaſed expence will be fully repaid.

Deep tillage is ſo very advantageous, that in populous countries where Agriculture flouriſhes, they every ſeven or eight years give their land a thorough digging with Spades and Mattocks *.

Some break the clods with Mallets; this is a good method, but it is tedious. Others paſs a Roller, more or leſs heavy, over fields that have clods: this is a very good way of

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* This method of digging land was in uſe in Italy in the time of Cato, and even of Columella, who terms it *Paſtinatio*.

preparing a field for being well plowed; but it muſt neither be too dry nor too wet; for if it was too dry, the clods would not be broke; and if too wet, the earth would cleave to the roller, and, as it were, knead the field.

It is often of great ſervice to make uſe of a roller armed with iron teeth, called a Rolling Harrow.

The common harrow, particularly when a little heavy, is not only very uſeful to break clods, but alſo gathers the roots of weeds, and ſtirs a little the ſurface of the land: but it muſt not be expected to do inſtead of plowing, as it only ſcratches the earth.

We ſhall hereafter ſpeak of theſe ſeveral inſtruments: it is now proper to return to what we have ſaid relative to the different ways of plowing uſed in the common culture of Wheat, and to annex a few remarks.

SECT. IV. *Of the Methods of Plowing for Wheat and Oats.*

Some Farmers turn in their ſtubbles as ſoon as harveſt is over; many burn the ſtubble before this firſt plowing; but moſt of them defer this work till after ſeed-time, and ſometimes even to the entrance of the ſpring;

not only that they may have time to gather the ſtubble, which ſerves to thatch houſes, fodder cattle, or heat ovens, but alſo becauſe they are buſy getting their lands ready for ſowing; and, finally, becauſe they are willing to keep it as paſture for their ſheep.

Farmers ſeldom give the firſt plowing, called Winter-fallowing, unleſs it is to lands they break up, or to ſuch part of their ground as they intend to beſtow two plowings on, for Barley or Peas. The plowing of the land for Oats is deferred till February or the beginning of March, that the fallow may be freſher, when they ſow in March or the beginning of April.

Such as turn in their ſtubbles directly after harveſt, or after Wheat-ſeed time, muſt beſtow a ſecond plowing before they ſow their Oats. Thus all their land is winter-fallowed; and they are commonly well paid at harveſt for the coſt of this plowing, which the others think to ſave; for plowings before the winter are always very beneficial to land. In wet ſprings the lands that have been winter-fallowed moſt be ſowed rather late, having imbibed more moiſture than the others; it is not, however, of any great conſequence.

During the whole month of March, and part of April, Oats are ſowed, and then Barley; and they are harrowed in. When they are come up, and three or four inches high, the Farmers take the advantage of a gentle rain having ſoftened the clods, and roll their fields with a wooden roller; which, by breaking the clods, gives freſh earth to the Oats, and lays the ſurface ſo level, that the Mowers can cut the corn near the ground; this is very neceſſary, as Oats grow to no great height.

Oats are cut either at the ſame time, or ſoon after Wheat; then begins the year of reſt or fallow, wherein the land is prepared to receive Wheat the following year. It muſt not, nevertheleſs, be imagined, that the plowing or plowings beſtowed on the Oats, are of no ſervice to the Wheat. It is certain they would be of more, if the Oat-ſtubbles were not in wet weather trampled by cattle. But even as it is, I am of opinion, that the land which has been twice plowed for Oats, is in a better condition to receive the plowings of the fallow year, which more immediately regards the Wheat. This induced me to mention Oats here, tho' I have more immediately in view the culture of Wheat.

The firſt plowing conſiſts in turning the Oat-ſtubble, and forming the fallow, which our Farmers call Fallowing. This may be done immediately after the Oats are carried off; but it is beſt deferred till after ſeed-time; 1. Becauſe the Farmers are buſy dreſſing their corn; 2. Becauſe by delaying it a little many grains ſprout, which are ſo many weeds deſtroyed; 3. Becauſe the Sheep have, in the mean time, the benefit of the paſture which the ſtubbles afford; 4. Becauſe to have this a good plowing the land ſhould be moiſtened, that the plow may go as deep as the nature of the ſoil will permit. On theſe accounts the Farmers wait till they have prepared their ſpring-corn lands. But it would be proper to begin to fallow as ſoon as ſeed-time is over; and the land ſhould be plowed deep, that the ſtirred earth may mellow in the winter. Tho' there ſhould be many clods, and the earth ſhould be kneaded, it is of no conſequence: the winter-froſts will ſet all to rights; for we ſuppoſe it proper that the fallowing ſhould be finiſhed before the hard winter-froſts came on; tho', in general, our Farmers do not begin fallowing till they have ſowed their ſpring-corn.

Soon after the fallows are all made, the plow is put into the lands that were firſt plowed; and this ſecond plowing, which is given about St. John's Day, is called Twifallowing. At this plowing the earth ſhould not be too dry nor too wet: for it is beſt that it ſhould neither knead nor fall into clods; for the winter being over, no benefit is to be expected from froſts. No bad conſequences can enſue from plowing as deep as the ſoil will permit; but in countries where they plow flat, care is taken that the furrows of the ſecond plowing croſs, and perpendicularly cut thoſe of the firſt. In plowing in ſtitches or ridges, what we have ſaid in the ſecond ſection, where we treated of the different methods of plowing, muſt be attended to.

Finally, immediately after harveſt, they give the third and laſt plowing, after which they ſow.

The nature of lands, and the different ſeaſons, prevent the courſe we have laid down from being always obſerved.

1. When lands bear much Graſs, they do not plow it deep, but give it five plowings; in this caſe they turn the fallow before ſeedtime, plow it again before Chriſtmas, give it a third plowing in ſpring, another before harveſt,

veſt, and the laſt juſt before ſowing, or at the time of ſowing, if it is ſowed under furrow.

2. On ſtiff lands, which do not bear much graſs, they beſtow but three plowings. Thus they fallow after the ſpring-corn is ſown, give the ſecond plowing in ſummer, and the laſt when they ſow. If it was poſſible to fallow the land before the hard winter-froſts, they would be better prepared; but the horſes are then generally too much taken up in preparing the land for the ſpring-corn.

3. Some lands would be made leſs fertile by plowing too deep, and others are improved by deep plowings. On this occaſion, I remember to have ſome-where read, that certain people, very aſſiduous in Huſbandry, made one plow follow another in the ſame furrow, in order to ſtir the earth to a greater depth: this might, in ſome meaſure, ſupply the place of the manual labour that is in certain countries beſtowed on the land, from time to time, to give it depth. In ſome provinces they make the furrows ſo deep, that they are obliged to put ſix Oxen to a plow; and theſe deep plowings are very beneficial before the winter; for the rougher the plowing is, the better hold the froſt takes of the land, and mellows it finely.

4. Farmers that have ſtrong teams ſometimes give their lands an extraordinary plowing in years when the weeds thrive a-pace.

5. Works are ſometimes interrupted by great drought, but much more ſo by immoderate rain; the times of plowing are then altered. Nevertheleſs, knowing Farmers in ſome meaſure guard againſt this diſorder, by pitching upon ſuch lands as ſuffer leaſt by being plowed in improper weather. For inſtance, in rainy weather, tho' the plow would knead ſtiff and clayey ſoils, it has not that effect on ſandy or ſtony lands: in dry weather, in ſome ſoils only large clods would be raiſed, whilſt others plow well. One great advantage of frequent tillage is, that lands, even in the dryeſt ſeaſon, ſcarcely ever grow ſo hard as to refuſe admittance to the plow.

6. On hills the furrows muſt be parallel with the baſe, not up and down; not only becauſe the plow works better in that manner, but alſo to guard as much as poſſible againſt land-floods and torrents of water.

7. The ancients adviſed not to plow when the land was very dry, very wet, or in froſty weather.

I have already taken notice of the diſadvantage attending the plowing land when too wet.

With reſpect to drought, it ſometimes ſo hardens the ground, that the plow would ſooner break than enter it; and if it even could be plowed, it would turn up in large clods. But there is no danger of impoveriſhing it by theſe plowings. Plowing in dry weather is even beſt for deſtroying weeds; and when land is in good order, it is ſeldom ſo dry as to hinder its being plowed.

With reſpect to froſt, if it is ſevere, it is impoſſible to make the plow enter the land; but there is no fear of chilling the ground, as the ancients thought; on the contrary, froſt breaks it to admiration.

We have already mentioned what ſhould determine us to plow flat, in ſtitches or in ridges.

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CHAP. III.

Of Manures.

TO have good crops, it is not enough to have plowed the land well, and as often as is neceſſary, according to the nature of the ſoil, but it is alſo requiſite it ſhould be enriched by good manures; ſome lands cannot even do without them.

Mr. Tull, who is no friend to dung, endeavours to prove, that it may produce bad effects, and that the uſe of it, at leaſt, may be diſpenſed with, without leſſening the crops.

The reaſons which this lover of Huſbandry brings in ſupport of his opinion, have not prevented me from defending the uſe of dung. I even thought myſelf obliged to invalidate ſome of Mr. Tull's principles, by ſaying that † no-body can deny the utility of dung, without ſetting at nought the experience of all ages and nations. I was content to affirm, that, by encreaſing the number of plowings, the want of dung might, in ſome meaſure, be ſupplied; for it is certain, that if a piece of land is badly plowed, and cannot be dunged, it will produce nothing; on the contrary, that ſame piece of land will yield good crops, if, without being enriched by dung, it is frequently and carefully plowed. I have alſo remarked, that the moſt plentiful crops may be had when manures can be joined to good tillage. If, therefore, I have enlarged much in the preceding chapter on the neceſſity of plowings, it was not with any view of depreciating manures; but becauſe I am of opinion, that, thro' idleneſs and negligence, plowing is not ſo much attended to as it ought. Far from diſapproving of the uſe of manures, I have conſtantly exhorted ſuch as intereſt themſelves in the improvement of Huſbandry, to aim at rendering them leſs coſtly and more plentiful; for by that means good Farmers, by joining a large quantity of manure to good tillage, would be in a way of having the beſt of crops. It is well known that we are ſupplied with good manures from minerals, vegetables, and animals. I ſhall ſet forth in as many ſections the aſſiſtance we can derive from theſe different matters.

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† Cult. des Terres, t. i. p. 60.

SECT. I. *Of Manures obtained from the Mineral Kingdom.*

1. All earths that are not improper for vegetation, and that have been long without producing any thing; in a word, all freſh earths, being ſpread on fallows, make good manures.

But of them, earth that has been gathered in heaps, and the banks of ditches, are to be preferred.

In ſome provinces where they make walls with a vegetable earth, beat into a kind of mortar, and mixed with ſtraw, which they call *Torchis*; the rubbiſh of theſe old walls makes excellent manure. This makes it evident, that the long-continued influence of the air, rain, ſnow, and ſun, which theſe old walls have received, has enriched the earth of them; and for this reaſon the worſt earth makes good manure, when it conſiſts of the rubbiſh of theſe old walls.

2. The ſcowrings of ponds, particularly if they are frequented by cattle, make very good manure; and it is not to be wondered at, ſince the water with which theſe ponds are filled, runs off the neighbouring lands, and is ſtrongly impregnated with the ſubſtance of the dung. The ſame cannot be ſaid of mud taken from ſmall rivers of running water; it dries in the air, hardens in the ſun, and is not at all proper for vegetation; but this mud is a very proper dreſſing for low and marſhy meadows.

Nothing is ſo rich as ſea ouze; but this manure is to be uſed in very moderate quantities; for it is well known, that when the pure ſea-water overflows a field, all the plants in it die; but, on the contrary, brackiſh water increaſes encreaſes its fertility. The Farmers in the neighbourhood of the ſea do not carry away the pure ouze; they bring loads of damaged ſtraw, and, kneading it in the ouze, carry it back impregnated and loaded with the mud; they lay it in heaps, and, when the ſtraw is rotted, ſpread it on the land.

Another remark, with reſpect to river-mud, is, that moſt great rivers which run on a bed of ſand, cover all the lands with a barren ſand, which they overflow when they break down their banks. But, if they innundate the lands by flowing over their banks, they depoſit a fine rich mud, which manures the land for many years.

Snow is eſteemed a manure. I could never extract any think from melted ſnow: I am, therefore, of opinion, that if ſnow fertiliſes the earth, it is becauſe, as it melts by ſlow degrees, the water that comes from it inſenſibly penetrates into the land; on the contrary, rains run off into the bottoms, without ſoaking to any depth into the land on which they fall.

Lands ſituated at the foot of mountains, and overflowed by the water of ponds above them, receive thence a manure which greatly enriches them.

With reſpect to pond-mud, it ſhould lay ſeveral years to mellow before it is laid on the land, it is otherwiſe heavy and very difficult to plow. Another defect of the ſcourings of ponds, is, that it breeds a number of weeds. A multitude of ſeeds are preſerved in this mud under the water, which ſprout when they are expoſed to the air, and feel the heat of the ſun.

This remark ſhould induce us only to ſow ſpring-corn and pulſe on lands dreſſed with pond-mud; becauſe, as they are not long in the ground, the land may be plowed immediately after harveſt, and, by this means, the weeds are got the better of, which would otherwiſe overpower the Wheat, and choak it.

3. We have already remarked, that ſand, tho' in itſelf barren, is very proper to make clayey ſoils fit for plowing, and for nouriſhing grain, either by diminiſhing their tenacity, or by opening paſſages for the water and the ſun-beams. I am apt to think that ſome ſands are more proper for this purpoſe than others; for inſtance, the ſand near the ſea, which is ſomewhat impregnated with ſalt, is a very rich manure. I am, alſo, apt to think, that ſand compoſed of particles of calcarious

ſtones, would be more proper than ſuch as are compoſed of fragments of cryſtals and flint.

My reaſons for theſe conjectures are as follow: I know fields ſo covered with calcarious ſtones, that the earth is not viſible; yet theſe fields produce very good Wheat. The free-ſtone uſed about Petiviers, in Gatinois, is very hard; it takes a poliſh like marble. Here and there are ſeen in it ſhells, ſome of which are filled with a kind of ochre, others with a cryſtalline ſubſtance: in fact, theſe ſtones are calcarious; that is, lime may be made of them. Some of theſe having been cut on the graſs-plat of a garden, when the work was done, all the chippings of the ſtone were carefully gathered, ſo there remained on the graſs only the ſmalleſt fragments, and the duſt that was made in the working.

The following year the graſs grew with remarkable vigour in the ſpots where the ſtone was cut: it was greener and higher there than elſewhere; and this vigour continued ſeveral years. I could not have thought that ſo hard a ſtone, by being reduced to powder, would have had nearly the effect of marl. Perhaps the good effects of lime in part depends on the ſtones being reduced, by calcination, to a fine duſt. It is probable that, in the very ſtony fields I have mentioned, their fertility ariſes, from the duſt formed by the friction of the ſtones one againſt the other, their ſurfaces being ſoftened, and, as it were exfoliated by the air. I only mention this occaſionally; for I have no intention of recommending the pulveriſing of ſtones for manure, unleſs it is by calcination, as I ſhall ſet forth.

4. Land may be enriched by quick lime; and, as this method may be very profitable to ſuch as have plenty of wood and lime-ſtone, it is neceſſary to enlarge on it.

We ſhall eſtabliſh our Hypotheſis on a * piece of land one hundred rod ſquare, each rod twenty-two feet long.

We muſt alſo ſuppoſe, that a firſt plowing has been given in March to a paſture intended to be ſowed with grain. Some ſhort time afterwards, the lime is carried from the kiln to the field, in the proportion of ten thouſand pounds weight to an arpent, or acre, and it is diſpoſed ſo as that there ſhould be a heap of one hundred pounds weight on each rod. Thus the heaps will be at a rod diſtance one from the other.

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* The contents of a French arpent, or acre, in French meaſure; it differs ſomewhat from that uſed in England.

The ground is then raiſed round each heap in a border about a foot thick: after which the whole heap is covered in form of a dome, and this covering conſiſts of earth about half a foot in thickneſs.

The lime ſlacks under this earth, and falls into powder. But as its volume is then encreaſed, it burſts its covering of earth: theſe heaps ſhould be, from time to time, attended to, in order to cloſe the breaches with freſh earth; for, without this precaution, the rain would get thro' the cracks, and reduce the lime to a paſte, not eaſily ſpread on the land when the heaps come to be broke. The tops of the heaps muſt not be flatted with the back of the ſhovel, as the lime ſhould remain in as light a powder as poſſible within the heaps. When it judged that the lime is reduced to a fine powder within the heaps, the ſlacked lime is well mixed with the earth that covers it; and the whole, being gathered into a little heap, is left for ſix weeks or two months; for then the rain does not injure it.

About June they ſpread this mixture of lime and earth on the fallow; but it is not careleſsly ſcattered: on the contrary, they take it by ſhovels full, and lay it in little heaps over the whole of every rod of land.

They imagine that theſe little heaps promote vegetation more than if the mixture was uniformly ſpread over the whole field; neither are they anxious at ſmall ſpaces being betwixt each heap. If they mean to ſow Buck-Wheat, they then give it one plowing; if Wheat, two or three.

As in many provinces lime is very dear, ſome Farmers put only five thouſand pounds weight on an arpent, or acre, in other reſpects treating it the ſame. But as ſoon as they have thus ſpread their lime, they lay on the ſame field ten or twelve load of good dung. This ſecond method is generally followed in mending lands that have been ſome years before limed; for they ſay, that it hurts the land to mend it twice together with lime alone.

Lime generally enriches much; it is not, however, proper for very light ſoils.

M. de la Morliere, of Bayonne, having cauſed ſixty pounds of lime to be ſlacked with water, and reduced to a kind of milk, and afterwards ſpread on a ſpot of ſix hundred fathom ſquare, the Wheat was finer than on the adjoining land which had been well dunged. This is a method of uſing lime, which, in ſome circumſtances, may be very proper.

Lime may alſo be mixed with dung-heaps; but we ſhall treat of that elſewhere.

Plaiſter, which is a kind of lime, is alſo a very good manure, and this virtue is preſerved even in rubbiſh plaiſter reduced to duſt. The ſame may be ſaid of lime; for old rubbiſh of mortar made of lime and ſand does wonders; but particularly on ſtrong lands.

5. We have already ſaid, that light lands may be mended with clay; but this requires caution. In the firſt place, all clays are not proper for this purpoſe. It appears to me that vitriolic clays do not promote vegetation; theſe kinds, therefore, ſhould not be uſed; and the beſt way to diſtinguiſh them is to make a trial on a ſmall ſpot of land. On the other hand, if lumps of clay, as they are dug out of the ground, were to be laid on a ſandy ſoil, they would not moulder to mix with it. It will be neceſſary, therefore, to dig clay two years before it is ſpread upon light lands, that the impreſſions of the atmoſphere, ſun, rains, and froſts, may have begun to ſeparate its parts, and on this account it muſt not be laid in heaps, but ſpread, in order to encreaſe its ſurface. When it appears ſufficiently mellowed, it ſhould be laid on the land before winter, that the froſts may

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compleat the diviſion of its parts. It is alſo proper to let it be dried on the land before it is plowed, that it may in part be pulveriſed.

We cannot determine the quantity of clay to be laid on an acre, for that depends on the quantity of the land to be improved as well as of the clay; ſuch clay as has already a great mixture of ſand muſt be laid on in greater quantities than that which is pure, However, nearly the ſame quantity of clay as of marl may be uſed.

Marl * is well known to be an excellent manure. But it muſt not be imagined that every kind of marl is equally good.

This treaſure it not found on every eſtate; it is neceſſary to know how to diſtinguiſh marl from clay, chalk, and white virgin earth; becauſe ſome of theſe earths are of more hurt than benefit.

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* We have made ſome experiments on two ſorts of Marl, one green and fat, the other white and chalky. 1. Both one and the other ſlacked, and were reduced to powder by being only put in a damp place; but the fat marl was more ſpeedily reduced than the other. 2 Both of them melted in water quicker than in the damp air; but the firſt ſooner than the laſt. 3. All the acids took a briſk hold of both of them. This is not the caſe with clay, on which acids have a very weak, and ſcarcely viſible, effect. 4. Clay, on being expoſed to the fire, grew red, and was burnt like a brick; the marls were only hardened: on increaſing the fire, the fat marl vitrified, even when calcined in a crucible; the white did neither vitrify nor turn to lime: perhaps the calcination was not continued long enough.

The marks by which they conjecture from the ſurface of lands, whether they contain marl are very uncertain. The beſt way of knowing it is to bore the land in different places with the auger which they uſe in ſearching for coal-mines, or dig pits to find the nature of the under ſtrata. Very uſeful obſervations may be made by examining old wells that have not been lined with brick or ſtone-work.

It is not poſſible to judge at what depth marl is to be found. Some is ſo near the ſurface as to be cut by the plow-ſhare: this is eaſily ſeen. One may expect to find marl at a ſmall depth when there is found immediately under the bed of mould a grey ſandy earth, having at firſt ſight the appearance of pot-aſh. Marl is often found under a bank of bluiſh barren clay. In fine, this earth is generally found in places where the ſtones are calcarious. But theſe ſigns, at beſt but uncertain, are not at all to be met with when the marl lays twelve, fifteen, thirty, forty fathom deep. On finding an earth ſuſpected to be marl, it is neceſſary to know how to diſtinguiſh it from clay, chalk, and virgin earth.

We have already mentioned, in the chapter in which we treated of the different earths, that the chief character of marl conſiſted in its being diſſoluble by acids, in its not baking in the fire like Potter's earth, which diſtinguiſhes it from the clays. Farther it ſhould, after a time, diſſolve in the air and water, like quick lime, and fall into a fine powder: this property diſtinguiſhes it from clays, boles, and chalks. When marl is dry, it ſhould be friable betwixt the fingers, and unctuous like lead ore: being wetted, it ſhould be ſoft to touch, and ſlippery betwixt the fingers; on the contrary, virgin earths are rough and harſh like a very ſoft ſtone.

In other reſpects, marls themſelves differ: ſome, even in the pit, are ſoft, and may be kneaded, whilſt others are as hard as ſhards: on this account, marls are divided into gravelly, ſhelly, chalky, and clayey.

Gravelly marls, which are generally the worſt, are found near the ſurface of the land.

The ſhelly marls, which are much better, are met with at a greater depth; they are commonly white, and come out in ſhards, or irregular broken pieces.

The chalky marl is found at a ſmall depth; it is white and reddiſh: it has a ſudden effect, but it does not long continue. It is called Crayon.

The clayey marl is often found under the beds of Crayon; it is ſeldom met with but in ſcattered maſſes, forming no regular ſtratum. It is blue and yellow; the blue is the beſt, and its good effects continue longeſt.

The marl which comes out of the pit in ſhards, or rugged ſtones, whether it is chalky or ſhelly, may be immediately laid in little heaps on the land; but as for the clayey marl, it is beſt to leave it at leaſt a year to mellow before it is uſed.

When the ſhelly ſtony marl is uſed, ſix waggon-loads, drawn by four good horſes, is enough to mend an acre of land; but if the marl is very clayey, there muſt be fifteen or twenty.

I have been in provinces, where, according to the quality of the marl, they laid from twenty-five to thirty-five tumbrels on an acre of land. The tumbrels, I am ſpeaking of, held eighteen buſhels; ſuch meaſures as would contain ſixty-five pounds of Wheat; but they heap the marl.

It is neceſſary to obſerve, that the quantity of marl to be uſed, differs according to the quality of the land to be mended, and the goodneſs of the marl: for a light, ſtony, ſandy ſoil ſhould be leſs marled than one that is ſtrong, ſtiff and clayey. In general, it is dangerous laying on too much marl, as the land then appears moſſy in the winter: it produces no graſs, nor, indeed, any thing but wild poppies for five or ſix years. It is, therefore no eaſy matter to proportion the quantity of marl to the nature of of the land. Therefore good Farmers, at firſt, lay on only half the quantity they think the land will bear; and five or ſix years afterwards, they lay on the other half; and if the marl has enriched the land much, they lay leſs on the ſecond time; but more if the contrary is the caſe. They are, by this method, in no danger of loſing ſeveral crops.

To explain what I have ſaid, I ſhall mention a circumſtance. I know a piece of land, near Paris, where, on digging, there is immediately found a reddiſh fine earth, which the people there call Red Crayon; under this layer, another is found like it, but white; this is called White Crayon: on continuing to dig, a greeniſh and very excellent marl is met with.

Theſe two kinds of crayon enrich lands much: their effect is even more perceivable, and ſhews itſelf ſooner than that of pure marl; but it does not hold ſo long; for at the end of twelve or fifteen years, freſh crayon muſt be laid on; whereas pure marl laſts twenty-five or thirty years. It thence follows, that the Farmers would willingly uſe only crayon to enjoy the benefits the ſooner; but the Land-owners chuſe the true marl, that they may not have their work to do ſo ſoon over again. They lay on the marl I am ſpeaking of, in the proportion of three cubical fathoms on an acre, and the expence of digging and carriage amounts to, from twenty-four to thirty ſhillings. It is the landlord that is at the expence of marling land; and it cannot well be otherwiſe, according to the common cuſtom of marling ſucceſſively, almoſt all the fields of a farm, ſince if the landlord at the expiration of the leaſe, ſhould let the land to another tenant, the Farmer would lay out a conſiderable ſum of money without receiving any benefit from it. Three inconveniencies, however, attend this cuſtom.

Firſt, the Farmer loſes almoſt an entire crop of Wheat: for it is well known that Wheat does not thrive well the year the marl is ſpread, unleſs great quantities of dung be laid on alſo; and this is impoſſible when all the fields of a farm are marled.

Secondly, the marl does not fully diſcloſe its virtue till the third year, tho' ſome difference is perceived in the ſecond: it continues in vigour till the twelfth or fifteenth year; after which the virtue gradually decreaſes. This inequality in the produce of land is very heart-breaking to Farmers, who ſee their crops grow every year leſs.

The third inconvenience reſpects the Landlord only, who is under a neceſſity of laying out every twenty-five or thirty years a conſiderable ſum of money, or no-body would take his land; for many Farmers are of opinion, that where land has been once marled, if that practice is diſcontinued, they are reduced to a worſe ſtate than if they had never been marled at all.

All theſe inconveniencies are remedied by dividing the total amount of the acres contained in the farm, by the number of years they know the good effects of marl will continue.

Let us ſuppoſe, for inſtance, that a Landowner has a farm of three hundred arpents, (or French acres) which he lets for two thouſand livres (each about ten-pence ſterling) a year; if he divides the three hundred acres by twenty-five it will produce twelve arpents to be marled every year. And, ſuppoſing each arpent to coſt him twenty-four livres marling, his annual expence will be two hundred and eighty-eight lives. But almoſt every Farmer is at the expence of carting the marl, which reduces it to one half; ſo that the Landlords annual expence will be only one hundred and forty-four livres. The farm may then be let for nineteen hundred inſtead of two thouſand livres a year, on condition of the Tenant's engaging to marl twelve acres every year; and a Farmer that ſhould refuſe this condition would be his own enemy, not only becauſe his land would be always in the ſame ſtate, as by the method I propoſe, there would always be ſome fields newly marled, many in their full virtue, and others on the decline; but alſo, as he would have only twelve arpents to marl every year, he could lay plenty of dung on them, ſo as not to loſe a ſingle crop; which could not be done if all the land in the farm was marled at the ſame time.

To remedy the inconvenience attending freſh-marled land, one might alſo lay on the marl when the lands were prepared for ſpring-corn; for by this means, which, however, I have not tried, the marl would have two years to diſſolve and mix with the earth before the firſt crop of Wheat would be ſown.

There are certain marly chalks that are good to mend land; but I here again repeat it, the ſureſt method, when the condition of the land is not well known, is to make ſmall experiments, and wait two or three years for the event, ſince it is certain, that the good effects of marl do not ſhew themſelves in leſs time.

Some aſſert that marl ſpoils land, becauſe, when its virtue is ſpent, the lands become more and more barren, according to the nature of the ſoil. But, in my opinion, the occaſion of this barrenneſs is, that the land, after the virtue of the marl is ſpent, reverts to the natural ſtate it would have been in had it never been marled. Thus it is only neceſſary again to marl this land, to recover its fertility.

Marl then is an inexhauſtible treaſure; but we muſt not deceive ourſelves in thinking it equally good for every kind of land: marl is properly ſuited only to cold moiſt lands, or ſuch as produce plenty of weeds. It warms, cleans, and ſweetens theſe ſoils; it diſunites their too compact particles; whence proceed the good effects we have mentioned. But, for theſe ſame reaſons it does not agree with lands that are ſandy, light, and have no ſubſtance.

This manure may be profitably laid on damp meadows; but it by no means agrees with ſuch as are naturally too dry.

When a field is marled, it ſhould have the cuſtomary plowings, and ſhould be alſo dunged as uſual; for it may be depended on, that the dung, which in cold lands, would have but a ſlight effect, will, with the aſſiſtance of the marl, enrich the ſoil greatly.

7. Some manures are peculiar to certain diſtricts; and it will be proper to make them known, that every one may ſearch whether he is not poſſeſſed of a hidden treaſure. Some leagues from Tours, there are in the earth large beds of foſſil ſhells, ſuch as are collected to adorn the cabinets of the curious; but are here applied to quite another uſe, to amend the ſoil; they ſupply the place of gravelly marls. Theſe ſhells are in that province known by the name of *Falum*; and the pits where they are dug, are called *Falumieres*. Theſe foſſil ſhells are ſpread on the land, and enrich it much.

Large *Falumieres* are met with at Saint-Maure, on the road to Poitiers, eight leagues from Tours. This bed of ſhells is above three leagues long, and it is imagined extends much farther. Its thickneſs is from ten to twelve feet, and it is found five or ſix feet from the ſurface. Many ſhells are ſeen whole; but moſt of them are broke and mixed with ſand of the ſame nature as ſea-ſand.

They dig the *Falum* in autumn to ſpread it immediately on the fallows; and in winter they alſo dig it, diſpoſing it in heaps on the land to be mended.

The good effects of this manure is viſible the firſt year, and its virtue laſts five or ſix. Theſe ſhells are by degrees diſſolved and reduced to powder; ſo that, at the end of ſix years, ſcarcely any remains of them are to be ſeen. This manure is particularly adapted to ſtrong ſoils.

It is impoſſible to aſcertain the ſum it coſts to mend an acre, becauſe the *Falum* coſting nothing, the whole expence is the carriage, and that is more or leſs according to the diſtance of the land from the pit.

Lands on which this manure has been laid ſhould be dunged, the ſame as if they had been marled.

8. The late M. Dumain, Engineer to the King, being detained by his employ in Hainault and Artois, made ſome obſervations on a foſſil, which may be uſefully employed in mending lands. It cannot be amiſs to relate the obſervations he communicated to me; as probably the ſame kind of earth may be met with in other countries; and, in this caſe, a careful Farmer might give this foſſil a trial.

The foſſil we are ſpeaking of is an earth of a blackiſh colour, reſembling peat; of which nature I ſuppoſe it to be. When it is burnt, there ariſes from it a ſulphureous, thick, and diſagreeable vapour. This earth muſt have ſome degree of moiſture, to make it burn more eaſily, and, at beſt, it is ſlowly conſumed. When once it has taken fire, it moulders away of itſelf, but in a dull manner, and without the appearance of flame.

This earth is cauſtic; for in kneading, in its preparation in the manner hereafter related, it bliſters the ſkin of the hands and feet of the workmen; this they are therefore obliged to guard againſt. Its aſhes are equally cauſtic, and the labourers that ſpread them cannot preſerve their hands from injury, particularly in damp weather.

This earth naturally lays in veins of various ſizes, which are ſometimes ſeven or eight feet deep and from thirty to forty long; they have been even known to extend from fifty to ſixty fathom; they are then often loſt, and it is perhaps at a league diſtance that their courſe is again diſcovered. Theſe veins are commonly found near the ſurface of the earth, and ſeldom at a greater depth than twelve or fifteen feet.

It is only in watery places this earth is met with, ſo that, before they can dig it, they are ſometimes obliged to drain the land; it diſcovers itſelf by an oily pellicule ſeen on the ſurface of the waters near it.

Three pounds of this earth being diſtilled in a retort, gave ſixteen ounces of an oil, or bitumen, much reſembling that extracted from pit-coal: the caput mortuum being waſhed, yielded about half a pound of copperas. I ſhall now deſcribe the manner of preparing this earth to make it yield a manure.

They throw water on it, and tread it, till it is reduced to paſte. They then make it into cakes of ſeven or eight inches diameter: theſe are ſet to dry, care being however taken that they have ſome moiſture left, for without it the earth would not take fire.

When theſe cakes are properly dried, they are piled one upon another in form of a pyramid, in ſuch a manner that intervals may be left for the fire to penetrate. Care is taken to contrive a kind of hearth at the bottom of the pyramid; here they put a little ſtraw and ſome bruſhwood to kindle the fire in the earth. When it has burnt two or three days, they ſpread the aſhes with a rake to cool, and that the inflammable matter may not be entirely conſumed; for if this was not done, they would burn a fortnight or three weeks, and the aſhes loſe a great deal of their virtue. The aſhes of ſome veins are white, and they are leſs eſteemed than ſuch as are reddiſh.

In April or May, about ſixty or eighty pounds of theſe aſhes are ſpread on each acre ſewed with corn, as well as on that which is kept in paſture; and in a week, even in the coldeſt ſoils, the plants viſibly aſſume a ſurprizing ſtrength and verdure.

The earth of all the veins is not equally good, and it is unneceſſary to remark, that when the aſhes are of an inferior quality, a greater quantity muſt be uſed. More of them muſt be laid on moiſt than on dry ſoils. The virtue of this manure is viſible two or three

years;

years; and it is not thought ſafe to dreſs the ſame land with it every year.

A company have ſome years ſince obtained an excluſive privilege of working a mine of what they call *Manuring Aſhes,* intended to manure land. I am apt to think this is no other than the earth I have been ſpeaking of.

Mr. Flavigny has diſcovered ſuch a mine at the depth of thirty feet near the villages of Anvi and Monigny, betwixt the towns of Ham and Laon. When they have dug this mineral they lay it in a heap; it heats by the action of the ſun only on it; and moulders to a red aſh, which they ſay is excellent manure, particularly for paſtures.

9. The aſhes of the foſſil-coal burnt in glaſs-houſes, brew-houſes, and other manufactories, are a very good manure for paſtures, whether natural or artificial. But the turf-aſhes, ſent by water as far as Arras from Amſterdam and other towns in Holland, are of a ſuperior quality. They are only uſed for paſtures, and not for Wheat, Oats, Flax, &c.

The aſhes of the turf that grows by the ſides of the canal from Liſle to Doway, are alſo uſed as manure; but they muſt be laid on in much larger quantities than the Dutch aſh.

The ſame may be ſaid of the turf-aſhes at Paris: for I have tried them on natural paſtures and clover; but I laid to the amount of about ſix ſacks on an acre.

Sect. II. *Of Manures produced from Vegetables.*

One of the great benefits of natural and artificial paſtures, is, that they ſupply a very good manure, without care, trouble or expence.

If you have at a diſtance from your houſe, a field to which it would be very troubleſome to carry manure; if you have any pieces of land on the other ſide of a bottom, thro' which the dung-carriages cannot paſs, it is only neceſſary to ſow them with Saintfoin or Lucerne, &c. theſe plants will yield plenty of hay for ſeven or eight years. And the land, being for that time reſted and enriched with the leaves and young branches that will have rotted on it, will be in a condition of yielding ſeveral as good crops as if it had even been dunged.

There is alſo another method of enriching land by its own produce. Sow Buck-wheat, Tares, Clover, Beans, and other ſucculent plants. When they are nearly at their full growth, and about to bloſſom, they are to be plowed in, and it ſerves as a manure, tho' we only return to the earth what it has already produced.

When the broad Beans are uſed for this purpoſe, as they are very good eating, they may, when quite ſmall, be gathered, and the plants after this gathering will ſtill be ſufficiently ſucculent to manure the land, provided they are without delay turned in.

In this way of manuring, the large *Navets*, called by the Engliſh *Turnips*, and by the Limouſins *Rabes*, or *Rabouilles*, are of wonderful efficacy. For this end, when the Turnips are full in leaf they feed ſheep with them, which eat part of the root; the remainder, as well as ſuch of the leaves as have been trampled on, rot on the land. The dung of the ſheep that have been long in a field eating Turnips contributes to manure it; and this alone is enough to make it yield fine crops.

On this occaſion, I ſhall obſerve that, tho' all annual plants are alike good for manuring land, yet moſt of ſuch as grow naturally in the fields, and which are called Weeds, ſcatter ſuch a prodigious quantity of ſeed that the land is infeſted with young plants, which grow with corn, and do great damage. This is not the caſe with plants that are ſown; for as they are turned in before they are ſeeded, and as they are not natives of the country there is no fear of their multiplying.

In general, vegetables are ſo much the more adapted to form manure as they are diſpoſed to putrefaction. Rotten plants are then a good manure, and there are ſeveral methods of making them rot.

Some cut ruſhes, heath, &c. on the commons whilſt they are green; they then ſpread them together with ſtubble and damaged ſtraw in hollow ways where the mud is collected, and in the ſtreets of villages where the cattle paſs. At the end of the winter they gather up theſe half-rotted vegetables with the mud, which they lay in heaps; and at the end of ſummer carry it on their Wheat-lands. Did they mix it with their dung it would be better, as I ſhall mention in the ſequel.

In Bretagne, where ſtraw is ſcarce and dung much more ſo, becauſe the cattle are almoſt always on the heaths, the Farmers make, in the fields they intend to ſow with corn, great heaps compoſed of a layer of ruſhes and another of turf alternatively. Theſe heaps remain eighteen months or two years expoſed to all weathers: the vegetable matter rots, and the whole mixture makes a good manure. M. France has tried this method, and found it anſwer, tho' he only made uſe of the turf of his avenues.

Dung compoſed of animal and vegetable ſubſtances rotted together, certainly makes better manure than the decayed vegetables I have been ſpeaking of alone. I ſhall again mention this in the ſection that treats of manures proceeding from animals. I ſhall conclude this by mentioning ſome vegetable ſubſtances, which cannot be of great ſervice but in places where they are very plentiful.

1. Aſhes of vegetables are much better than thoſe of turf. Wood-aſhes are commonly too ſcarce, as they are put to many uſes; particularly bleaching linen.

But in breaking up, or cobbing lands, it is uſual to burn the fern and heath, and the roots and ſtems of the graſſy turf, which yield vegetable aſhes, proper to enrich the ſoil. With this view M. Vanduffel cauſed a large quantity of fern to be carried on a piece of land he intended to ſow with corn, and burnt it there.

Such as live near large foreſts, where they carry on different manufactories in wood, may buy at a cheap rate the aſhes of the chips the workmen burn, and mend their paſtures with them.

2. In the neighbourhood of great cities, it is well worth while to buy ſoot of Chimney-ſweepers, which has a wonderful effect on paſtures, after the rate of forty buſhels (French) an acre.

3. As to Buck-aſhes, that is, aſhes of which lye has been made, they are commonly mixed with dung, or laid on the kitchen-garden to looſen the ſoil. Soap-boilers aſhes have ſalt enough remaining in them to have a good effect on meadows.

4. Tanners bark would be a good manure, if it was not for the moſt part made into cakes to burn.

5. Saw-duſt may be uſed as a manure when mixed with dung or aſhes.

6. The huſks of Grapes from the Wine-preſs may do alone; but the preſſings of apples and pears muſt firſt be well rotted; it is therefore beſt to mix them with other dung. This they do in Cyder countries with the preſſings of the apples; but thoſe of pears are often dried and burnt.

7. The leaves of trees and the cuttings of hedges would be good manure, if they were

not made uſe of as fodder for cattle. Some, however, aſſert, that dung heaps made of ſtraw are better than what are compoſed of leaves and dry plants.

8. M. Van-Eſlande has wrote me word from Warwick, that for ſeveral years paſt the cakes of Linſeed, Coleſeed, &c. after the oil has been extracted, are excellent manure. The two methods of uſing them are as follow:

The moſt ſimple way is to grind theſe cakes into powder in mills, or thraſh them with a flail on a barn-floor, and ſpread it on the land in the ſame manner corn is ſown. But it muſt be ſpread ten or twelve days before the corn is ſowed, otherwiſe the ſeed that may chance to be envelloped in it before it has been expoſed to the ſun's heat will not ſhoot.

The other method is to ſoak theſe cakes in water, carry it on the land and ſpread it. In this way there is no danger of preventing the ſprouting of the ſeed.

9. Sea-wreck, the algas, &c. and, in a word, all the ſea-weeds are good manures, whether they are rotted by mixing with dung, or burnt for aſhes to ſpread on their paſtures.

SECT.

SECT. III. *Of Manures to be got from Animal Subſtances.*

When dead animals are laid on land, they need no other manure, which proves, that the fleſh of animals enriches the land. For this reaſon the offals and cleanſings of ſlaughter-houſes contribute alſo to mend a ſoil.

This is not all: the chippings and ſhavings of horn, whalebone, bones, and even ivory, are bought to lay on the land.

The cuttings of parchment and leather would be very good in the ſame intention, were they not uſed in making glue.

In maritime provinces they carry ſhell-fiſh, either freſh or half rotten, to a conſiderable diſtance, and, leaving them for ſome time in heaps, they afterwards ſpread them on the land.

But the moſt common manure is ſupplied by the excrements of animals, either by itſelf, or mixed with vegetable ſubſtances. Theſe manures are particularly known by the name of dung.

Dungs are of four kinds; that is to ſay, human excrements, which, when they have been long expoſed to the air, are reduced to powder, and known by the name of Poudrette.

Columbine, which is the dung of pigeons, poultry, and all kinds of birds.

The dung of ſheep and goats, as well that which is gathered in the ſtables, as what theſe animals drop when they are folded.

Laſt, the yard-dung, which comprehends the litter that has been under the horſes, mules, aſſes, oxen, cows, and hogs.

In ſome provinces they buy night-ſoil, or the emptyings of neceſſary-houſes at a high price: they mix with it damaged fodder, and ſpread it in ſmall quantities on the land. No manure enriches ſo much; but it communicates a bad ſmell to vegetables; nice horſes will not eat oats that grew in a field wherein much of this dung had been ſpread. Perhaps the bad ſmell paſſes with the ſap into the grain; or, what is more probable, the coat of the grain contracts the bad ſmell that continually exhales from the field.

About Paris the police obliges the nightmen to carry the ſoil to particular places, the ordure dries, and is reduced to Poudrette: this the Farmers ſend for, and ſpread on their lands, which are thereby greatly enriched; but they uſe a very ſmall quantity.

I place among manures the ſoil or filth of great towns, which is partly compoſed of animal, partly of vegetable ſubſtances. The pickings of pulſe ſupply the vegetable part; the ſinks of the kitchens, the dung of animals, and the ſlovenlineſs of the inhabitants ſupply the animal part. Theſe manures are in time reduced to powder, and this powder is particularly excellent for ſtrong land.

There are two ſorts of dove-houſes, one open, the other covered.

In the open dove-houſes they lay litter; and, as the rain carries off a part of the pigeon's dung, only a few loads are got, which have no more virtue than ſheeps dung.

The dung is much better preſerved in covered dove-houſes; it is there pure, and unmixed with ſtraw. This is what they particularly call Columbine. Pigeons dung is much ſought for Meadows, Wheat, and much more ſo for Hemp-fields. This dung deſtroys the moſs and ruſhes that ſpoil the meadows, and, at the ſame time, gives a great vigour to the graſs. The only incovenience obſerved in the uſe of it is, that the feathers do not rot, but mix with the hay; this diſguſts the horſes, or, at leaſt, gives them troubleſome coughs.

With reſpect to Wheat, this dung has ſo much virtue that they ſow it by hand like corn, about five buſhels on an arpent: ſome ſow it with the ſeed; others, on the contrary, ſow it on the green corn in the month of March. If the year is cold and moiſt, this dung ſpread in ſpring time has a great effect. But if heats and drought enſue, as this dung is by nature very hot, it does more harm than good, particularly in light lands; in theſe circumſtances it is beſt ſpread in autumn. This is our practice.

With a well-ſtocked dove-houſe, you may dung ſix acres of Wheat in a year.

They ſpread litter in the ſheep-houſes, which, being mixed with the dung of the weathers, ſheep, and goats, yields a dung which has a conſiderable virtue, particularly in ſtrong lands. A flock of three hundred ſheep, kept in the ſheep-houſes all the year with plenty of fodder, will yield dung enough to manure at leaſt twenty acres. In the folding ſeaſon this flock will, beſides, manure eight acres, without fodder.

On an arpent, or acre of one hundred rod ſquare, each rod twenty-two feet French, they lay only four or five waggon-loads of dung taken from the ſheep-houſes, each as much as four horſes can draw.

The ſummer's dung is much better than that made in winter, becauſe the ſheep dung and urine much more when they eat plenty of graſs, than when they have dry fodder.

But, as this dung is taken from the ſheep-houſe to be immediately laid on the land, it is never well rotted; the ſtraw remaining entire, ſcarcely at all decayed. As ſheep's dung is of a very hot nature, and particularly adapted to ſtiff ſoils, it will be neceſſary to mix it with the yard-dung to allay its heat before it is laid on light lands. This mixture may be made by folding the ſheep in the yards, and even on the dung of other cattle.

The cuſtom of ſeveral provinces in folding their ſheep on fields intended for Wheat is excellent. This practice, which equally benefits the flock and the land, is not enough attended to. In ſome provinces, in ſpite of daily experience, they are ſo prejudiced as to imagine that this practice brings diſeaſes on their ſheep. When they ſaw M. France ſet up a fold in a province where the cuſtom was condemned, he was aſſured that he would deſtroy his flock; for that the chalky ſoil of Champagne had in it a dampneſs that would hurt the weathers, and damage their wool.

But theſe arguments, which ſeemed to have no foundation, did not cauſe M. France to deſiſt from his intention. He folded his ſheep, and found it anſwer: the wool was finer; and, without fodder, a greater number of acres were mended, which yielded fine Wheat.

I mention M. France in this place, to ſhow how ſlightly founded many prejudices in the provinces are; and of how much ſervice a ſenſible man may be to his neighbours, by making trials which open their eyes, and by pointing out a new track to them.

To make a great deal of dung it is not enough to have large flocks and a number of cattle; there muſt alſo be plenty of fodder: there muſt not only be feed for theſe animals, but ſtraw to ſupply them with litter. Hay may be procured by artificial paſtures: but ſtraw is almoſt always wanting. The beſt way of ſupplying this deficiency, is to make the cattle lie on the land that is to be dunged: by this means, a Farmer, who mends only thirty acres of his farm, may every year dung the thirty acres he intends for Wheat. Without the help of the fold, this Farmer, let him manage his fodder as he will, cannot at moſt dung above twenty acres; but with a fold, compoſed of twenty-four hurdles, proportioned to the land he works, and a flock of only three hundred ſheep, he will eaſily dung ten or twelve acres without the help of fodder: in this manner all the land may be dunged, which is a great advantage. It is well known that undunged lands of a middling quality, plowed after the uſual method, and ſowed with two hundred pounds of Wheat on an acre, yielded only ſeven hundred and twenty pounds of Wheat, taking one crop with another. It is alſo well known, that the ſame land, being well dunged and folded, and plowed in the manner we have directed, will yield fourteen hundred forty-four pounds of Wheat an acre. Thus, a Farmer who has no fold can only hope for this crop from the twenty acres he dungs; whence it follows that he, who by means of a fold can dung ten acres more, gains ſeven thouſand two hundred pounds of Wheat, without its having coſt him any thing extraordinary in ſeed, and ſcarcely any thing in harveſt work. There is another advantage, which, tho' not ſo conſiderable, is not leſs real. To make this appear, let us recollect that the ten acres of land which were folded, yielded double the corn they would have done, had they been neither folded nor dunged. It neceſſarily follows, that the produce will alſo be nearly double in ſheaves; that is, they will houſe thirty dozen ſheaves an acre inſtead of fifteen. Here then is a gain of one hundred and fifty dozen ſheaves on ten acres, and an increaſe of ſtraw to make dung and chaff for the cows. If there is more manure than is neceſſary to dung the Wheat-lands, it may be uſed on the Paſtures, Barley, Peas, &c. and the encreaſed crops of ſoft corn will be of great uſe to feed poultry, hogs, &c. and tend to the general advantage of the farm. We muſt not forget that the folded land, after having produced a good crop of Wheat, will ſtill be in a condition of yielding good Oats.

In Beauſſe they do not begin to fold till the middle of July. They might begin much ſooner; but are prevented by thinking it would be inconvenient. I am apt to impute it to prejudice; and hope that the examples of M. Dailly at Trou d'Enfer, and of M. Petit at Genainville, will induce our Farmers to fold much ſooner. When M. Dailly can no longer fold in the fields, on account of the froſt's making the ground too hard to drive the ſtakes, or of the lands being too miry for the ſheep to lie on, he takes them home; but, inſtead of ſhutting them up in his ſheep-houſe, he keeps them all the year in the open air, in a fold which he has made in his yard for that purpoſe. By this method his weathers, ſheep, and lambs, enjoy better health, and have finer wool.

Sheep are not the only animals that can be folded. M. Patullo ſays, that in England they ſhut up hogs in cloſes ſown with Clóver: beſides the graſs fattening them, the ſoil is enriched, and capable of producing fine Wheat.

Some good Huſbandmen have alſo formed a deſign of folding horned cattle, in order to dung a greater quantity of land without ſtraw: if large cattle could be folded in this manner without inconvenience, I am apt to think it might be advantageous.

It has already been remarked, that the litter taken from under the horſes, mules, aſſes, oxen, cows, and hogs, is called Yard-dung: this is all collected in a hole made in the yard, where the rotting of the ſtraw is compleated; and it is afterwards carried on the land.

To manure properly an arpent, or acre of one hundred rod, twenty-two feet to the rod, it will require eight waggon-loads of this dung drawn by four horſes. A yard in which ſix or ſeven horſes are kept, and ten or twelve cows will dung twenty-five acres.

M. Patullo complains that they do not give the dung leave to rot: in fact, it is cuſtomary to carry dung upon the land before the ſtraw is rotted. I have ſeen, however, ſome ſenſible Farmers put the litter as it came from the ſtables into holes where water was collected, and when it had been there for a time, it was taken out with forks, and laid in heaps at the edge of the dunghole, like beds in gardens; there it was left to rot; and this dung was not carried on the land till it was rotten enough to be cut with a ſpade or iron ſhovel: the juice of the dung remaining in the hole, ſerved to enrich and rot the freſh litter.

If dung was left till it was reduced to mould, a part of its goodneſs would be loſt. This method is only proper for paſtures, as thereby no dry ſtraw gets into Graſs, horſes being diſguſted with it. But they underſtand much better in Flanders how to make the moſt of their dung. Such is the virtue of manures in thoſe provinces, that the lands bear every year without interruption or reſt, Wheat, Oats, Barley, Coleſeed, Flax, Tobacco, &c. inſomuch, that a farm of forty acres will maintain at leaſt eight cows, two horſes, ſome hogs, and other ſmall animals.

Many Farmers complain, not without reaſon, that their yards are not proper for making good dung. It will not, perhaps, be diſagreeable that I ſhould mention the obſervations I have made on the ſubject, and point out in what manner a good dung-yard may be made: this article is of the utmoſt importance for enriching the land.

1. In ſome Farms the ſtable is ſeparate, and at a diſtance from the cow-houſe, ſo the dung of the cows and horſes are put in different places. The conſequence is, that the horſe-dung proves of little ſervice, as it will fall into duſt without forming a fat ſubſtance. It is then beſt that it ſhould be mixed with the cow-dung; this laſt enriches the other, which in return communicates a part of its heat.

Thus, when theſe two buildings are near each other, it is proper to order the ſervants that clean the ſtables to mix theſe two kinds of dung together, as well as the hog-dung.

2. The ſheep-houſes ſhould be ſo ſituated, that the flock may paſs over the dung every time they are driven into the fields, or return: for, at their coming out of the ſheep-

houſes, they empty themſelves on the dung, and their trampling is of ſervice. For this reaſon, when the flock is let into the yard for air, it ſhould always be ſtopped a-while on the dunghill.

3. It is proper to put the dung in a moiſt place, that it may the ſooner rot; but no great quantity of water muſt be collected in the dung-hole, becauſe too much water prevents any thing decaying: it is well known, that the ſofteſt and moſt periſhable kinds of wood, will laſt for ever, if always under water.

But, above all things, particular care muſt be taken that no water runs from the dung-holes. For, after having waſhed the ſtraw, it will carry off the excrementary part, which is principally uſeful for vegetation: this, however, is often the caſe.

Moſt large farm-yards have a pond to water the cattle; and the dung is ſpread over theſe yards on a bottom a little ſhelving towards the pond. In this caſe the rain and ſnow-water waſhes the dung, and carries into the pond the richeſt part of it; ſo that there remains in the yard only dry unſubſtantial litter, which, in dry ſeaſons, is reduced to duſt. This is a very conſiderable defect.

At other times, there is a hole for the pond, and another for the dung. But if there happens to be too much water in the dung-hole, it rots much ſlower than if it was only moiſt. Beſides, in great rains, the dung-hole overflows into the pond, and the water carries off the richeſt part. They are ſometimes even obliged to bucket the water out of the dung-holes.

I am of opinion, that in farm-yards there ſhould be two hollows ſunk: one for the pond, which ſhould not be in the middle of the yard; and the other for the dung: this laſt ſhould be over-againſt the ſtables. But almoſt all the drains ſhould be carried towards the pond, reſerving for the ſtercorary only what may be neceſſary.

If in certain ſeaſons the dung ſhould be too dry, a little rain-water may be brought into it, by means of a dam made of dung, which will direct the water to the ſtercorary, inſtead of the pond; in this method the dung will be always wet, but never drowned.

In ſome caſes, there might even be on the outſide of the farm-yard a ſmall deep pool, ſituated ſo high as to ſupply, by means of a drain, the neceſſary quantity of water to moiſten the dung in ſummer; and when this can be done, all the drains ſhould be directed towards the pond.

4. Farm-yards are for the moſt part expoſed from morning to night to the heat of the ſun, which burns the dung; ſo that there remains only rubbiſh of ſtraw reduced to a duſt. It would be of ſervice if the dung was defended from the mid-day ſun by buildings or trees.

5. When the litter is partly rotted in the ſtercorary, it ſhould be taken out with a dung-fork, and laid in a large heap in the angle of two walls ſhaded from the meridian ſun. But care muſt be taken, in order to make theſe heaps to the beſt advantage. Firſt, the dung that lay at the top of the ſtercorary muſt be put at the bottom of the heap. There muſt then be alternatively layers of dung and beds of ſtreet-dirt, or ſcourings of pools and ditches, which we have directed to be gathered in heaps at the end of the winter. Theſe earths, already of themſelves very good, imbibe the juice of the dung, and become excellent manure.

When the dung-heap is thoroughly rotted, it is carried on the land before the ſecond or laſt plowing; this method is preferable to carrying it on in ſummer, when the heat would dry it too much. It is put into tumbrels, and the labourer having driven it into the field, he unloads it in little heaps, taking part of the dung from behind, and part from before, that the weight may not bear too hard upon the Thiller. It is neceſſary theſe heaps ſhould be ſpread with iron forks over the ſurface of the land, and immediately plowed in.

M. Patullo would have all the ſtables paved, and a ciſtern in each to receive the urine of the beaſts. I muſt not forgt to obſerve, that M. Van-Eſlande is alſo a great advocate for theſe ciſterns. The moſt general and uſeful of our manures, ſays he, is the urine of cattle, hogs, cows, horſes, &c. which is received into ciſterns. He adds, that for ſome years paſt they have contrived to pump this corrupted urine into carriages. By this method, which is very expeditious, and keeps great part of the ſtink from the workmen, four acres may be manured in one day with two men and a carriage drawn by two horſes. The good effect of this manure ſurpaſſes any thing that can be ſaid of it.

I am far from condemning ciſterns: but I adviſe careful Huſbandmen, at leaſt, to have their ſtables paved, and to have gutters to convey the urine of the cattle into the ſtercorary, that by this means the litter may be ſo much the more impregnated with animal ſubſtances. Urine having a great tendency to ferment, may be deemed a kind of Leaven that will promote the more ſpeedy rotting of the ſtraw and other vegetable ſubſtances that are leſs diſpoſed to fermentation.

In ſome diſtricts of Bretagne, the Peaſants are ſo infatuated as to burn their dung, in order to ſell the aſhes to ſuch as want to mend their land. M. Le Marquis de Langle, Counſellor of the Parliament of Rennes, bought as great a quantity as he could of the aſhes: he mixed them with lime and ſea-ſalt; that is, firſt a layer of the aſhes, then one of ſalt, and a third of lime. This produced a very good manure; but much leſs profitable than the pure dung which the peaſants had burnt.

Animal ſubſtances can ſometimes too much enrich the land. I cauſed ſome Lime-trees to be planted in a piece of land that was damp, and very much dunged with manures proceeding from animals; ſuch as very rich dung from the ſlaughter-houſes, entrails, &c. As I ſaw the trees were dying, I cauſed them to be taken up, and in opening the ground, I obſerved there came forth a very fetid ſmell, and that all the young roots were rotted. Thus, tho' putrefaction is neceſſary to convert animal ſubſtances to manures, yet when theſe ſubſtances are in large quantities, and a putrid fermentation enſues, it may poſſibly affect the roots. This is well known to the Gardeners about Paris. They expreſs it, by ſaying, that their lands grow rank; that is, they become too rich; and, as many tender plants die, they lay them down in graſs to abate their rankneſs: after a few years, they are in a condition of yielding all kinds of Pulſe.

SECT. IV. *General Obſervations on Manures.*

I ſhall conclude this chapter with the diſcuſſion of a propoſition, eſteemed by many Huſbandmen to be a general principle.

As they perceive that many ſubſtances furniſh manures, they do not heſitate ſaying, that there is no ſoil but what contains within itſelf the manures that are beſt adapted to it. Dig, ſay they, the land, and you will find in it matter wherewith to mend the ſurface.

I agree, that there are certain lands in which the fertile earth is ſo deep as, by digging from time to time to a certain depth, to mend the exhauſted ſurface. But in moſt ſoils the earth that is met with in digging, is ſtubborn and abſolutely barren. I confeſs that marl, which gives lands a fertility that laſts twenty-five or thirty years, is often found under the land that has occaſion for its aſſiſtance; but every one is not ſo happy as to have marl on his eſtate.

If it is ſtone, virgin earth, or chalk, to uſe them as manures they muſt be made into lime, which is a great expence.

It is true, under a hungry ſand is ſometimes found clay that will give it ſubſtance; or, under a ſtiff ſoil, veins of ſand may be met with that will make it tractable: theſe are happy circumſtances, of which it will be right to take the advantage, when by ſmall experiments there is an aſſurance, that the profits to be expected will exceed the neceſſary expence of digging the manure, and laying it on the land.

It is alſo very fortunate for the Landholder to find, as in Touraine, veins of foſſil ſhells, which have the effect of marl, or a vein of any other foſſil manure.

This is what may be ſaid in favour of a principle which, tho' in certain reſpects true, has been made too general.

We may conclude, from what has been ſaid in this whole chapter, that it does not appear that, reſpecting manures, any general principles can be laid down. A ſtrong clayey ſoil may indeed be rendered more fertile, by adding to it ſubſtances that ſhall leſſen its tenacity; tho' it ſhould be a pure and barren ſand: but ſome ſands are more proper for this uſe than others. Subſtance may be given to a light ſoil, by a mixture of very ſtiff earths, even of clay; but there are clays that would do more harm than good.

Some chalks diſſolve in the air like lime, whilſt others, which are ſoft ſtones, do not ſeparate without difficulty; and if, after being divided, they are much wetted, they harden and become totally barren.

The mud of rivers is generally good manure: yet a neighbour of mine loſt a fine eſpalier, by carrying on it, at a great expence, the mud of a river of running water.

Neither is it proper to reaſon too much on the nature of manures, nor on their influence with reſpect to vegetation.

By the effects produced by aſhes, brackiſh water, recent ſhell-fiſh and ſea-ouze, it is evident that a very ſmall portion of fixed ſalt will give fertility to the earth. But if it is true that the ſap riſes in vapours, as Grew imagined, it is not to be ſuppoſed that ſalts, which will not riſe in vapours, can enter into the veſſels of plants.

The advantages accruing from dung and rotten vegetables are too well known to be called in queſtion; but it is not known whether they operate by detaining the moiſture that is abſolutely neceſſary to vegetation; by looſening the particles of ſoils that are too compact, that the roots may have power to extend; by exciting in the boſom of the earth a ſort of fermentation, by means of the fat and oily matters they contain, a fermentation which aſſiſts that kind of digeſtion by which the nutritive juice of plants is prepared in the earth; or finally, whether ſome parts of dungs, either oil or volatile ſalts, do not enter by way of food into the ſubſtance of plants.

But dungs are not the only manures that can with advantage be uſed; lands are greatly aſſiſted by dry ſubſtances void of oil or ſalts. A barren earth may make another fertile. Entire provinces enrich their land with ſtone calcined and reduced to lime: marl and alum cauſe a laſting fertility.

Sand, clay, plaiſters, and rubbiſh of old buildings ſeem to operate either by giving tenacity to light lands, or by making ſtrong lands leſs compact. Many of theſe ſubſtances may beſides, by their nature, be greatly aſſiſtant to vegetation.

Some dungs are particularly adapted to cold ſoils, as poudrette, colombine, ſheeps-dung, and horſe-dung. The dung of oxen, cows, and hogs, are of ſurpriſing efficacy, in hot, dry ſoils; but if dungs are managed as we have directed, they are equally good every where. As for what remains to be ſaid, it is beſt in large concerns not to attend too much to minute particulars; eſpecially when they interrupt the due and regular progreſs of the works of Huſbandry.

It is then neceſſary always to ſtick to facts, and reaſon by experience. But I cannot too much recommend it to the lovers of Agriculture, not to undertake any great work of the kind, without being firſt aſſured of ſucceſs by ſmall trials; theſe ſhew what the expence will amount to, and what profit may be reaſonably expected. It is true that the diſcovery of a good manure may enrich a Land-owner: ſuch ſhould continually be making experiments; but, as the carriage of earth is very expenſive, theſe experiments ſhould be made on ſmall ſpots, that the want of ſucceſs may not affect the Land-owner's fortune. And, after all, it is better to buy good land at once, than ſpend the ſame money in improving what is bad.

Peaſants that occupy their own lands argue differently, and with great propriety, as they have not wherewithal to purchaſe; their whole care ſhould be to improve their little demeſne. An example will beſt prove this. We are poſſeſſed of an extenſive fief, of which all the bad lands had no depth; a thin coat of bad earth being ſpread on a bed of white virgin earth, or on a ſtone quarry; and all this land was uncultivated. Our anceſtors having granted them at ſmall quit-rents to the Peaſants of a populous village, every man worked with aſſiduity to improve his own little quarter; and, by dint of digging and carrying off the ſtone, they have given depth enough to the ſoil, for it to be worked either by the hand or plow. This land, which they acquired with immenſe labour, was at firſt very bad; but, by dint of dunging and tillage, they have ſo far improved it, that as fine Wheat may be ſeen in this diſtrict as in the beſt lands of our Farms.

Had a Landlord attempted to have made theſe improvements with day-labourers, it would have coſt him four or five times the value of the beſt land. But in the hands of the Peaſants every little ſpot is gradually improved by the whole family.

If the weather is too bad to work in the land, they go home and dig ſtone, which they carry off in the froſt. The Landowner could not do better than beſtow theſe bad lands on the Peaſants; and theſe laſt now enjoy the fruits of their labours. But, for ſuch grants to have the wiſhed-for ſucceſs, it is neceſſary the country ſhould be populous.

Yet, let what will be done, the earth will always partake of its original quality: if good land is for a time neglected, it may eaſily be brought into order; but a bad ſoil needs continual aſſiſtance: theſe are only by art made fertile; whereas the firſt are ſo by nature; and it is a known fact, that lands which were two centuries ago eſteemed particularly fertile, ſtill preſerve the ſame reputation.

After having prepared the land, by breaking it up, by tillage, and manures, we ſhould chuſe the moſt profitable method of laying it out: this will be the ſubject of the enſuing chapter.

CHAP. IV.

Of allotting the Lands for Tillage.

SHOULD any one ſow Wheat every year in the ſame field he would have but indifferent crops: this is a fact too well eſtabliſhed by a number of experiments to be at all diſputed. The cauſe often aſſigned is that the earth, which the firſt crop had exhauſted of the juices adapted to Wheat, cannot continually ſupply that plant with food. It is on this account that in the ſame land they ſow ſucceſſively different ſeeds. M. Van Eſlande has informed me by letter, that there are in Flanders lands ſo fertile, that, by keeping them in good tilth, and aſſiſting them with dung, they yield every year, and without reſting, Wheat, Oats, Barley, Coleſeed, Flax, Tobacco, &c.

It may not poſſibly be ſo neceſſary as it is thought, to change the ſpecies of plants from one year to another, merely becauſe by this method the earth ſupplies a variety of nouriſhment. And if any advantage reſults from ſowing ſucceſſively different plants in the ſame land, this may proceed, 1ſt, from the quality of nouriſhment certain plants require; 2dly, From the particular conſtitution of each plant, ſome being more tender than others; 3dly, From the eaſe with which ſome of them extend their roots in the hard earth; on which account theſe laſt can better do without the uſual plowings, than the others.

Certain looſe hungry ſoils will yield Rye, Millet, Buck-wheat, &c. but have not nouriſhment enough for Wheat: this evidently proves, that all plants do not require of the earth an equal quantity of food.

To be convinced that there are plants which can penetrate very hard earth with their roots, it is ſufficient to reflect, that Oats grow tolerably well on a ſingle plowing, whilſt Wheat requires three or four.

I am apt to think that the advantages reſulting from the year of fallow, proceed principally from its affording time ſufficient to give all the neceſſary plowings, without, however, denying but that during the year of reſt the land may be benefited by the influences of the atmoſphere, rains, dews, ſnow, froſt, the heat of the ſun, &c.

Thence it follows, that every two years Wheat may be ſown on the ſame land; becauſe, by this method, there is a year to give the plowing proper for Wheat. But Wheat cannot be ſown every year in the ſame land, becauſe, from harveſt to ſeed-time, there is not ſufficient ſpaces to give the tillage that is neceſſary.

Many Huſbandmen, depending on the great fertility of their land, have ſowed them ſeveral years ſucceſſively with Wheat; but they have had reaſon to repent it.

Why ſhould Wheat ſucceed well after turnips, potatoes, and maize? It is becauſe theſe plants are ſowed on a well-mended and well-tilled ſoil; receive beſides two or three good hoeings, whilſt they are in the ground; are gathered in dry weather; and are well-guarded from cattle, which neither trample nor knead the land. And it may be added, that they give the land another ſlight plowing before the Wheat is put in, which, by this means, has all the benefit of a ſoil wonderfully well tilled.

As Oats can ſhift better than Wheat without a looſe mould, they ſucceed well on a Wheat ſtubble twice plowed, or on a Saintfoin lay; and it ſhould, beſides, be remembered, that as ſoft corn is not ſowed till March, there are betwixt harveſt and the ſpring ſeed-time opportunities to beſtow the neceſſary plowings.

Theſe then are, in ſhort, the chief motives for laying out lands according to the different ſeaſons of ſowing, and ſowing them ſucceſſively with different grain. There are other reaſons for laying out lands differently: we ſhall in the ſequel make them known.

SECT I. *Of the Diviſion of Lands into two or three Portions or Allotments.*

I ſhall not undertake to relate in this place the different methods of laying out lands, in uſe, in the ſeveral provinces of the kingdom, tho' it is a ſubject of great importance in Agriculture; but I cannot with propriety avoid comparing the cuſtoms of dividing lands into three portions with that eſtabliſhed in ſeveral very fertile provinces, where they only divide their land into two portions. If the land is well adapted to Wheat, they only ſow

Rye, to make bands for the ſheaves; on the other hand, where Wheat will not ſucceed, it is better to have plentiful crops of Rye. Some lands are better adapted to Oats than any other grain; others will only yield Buckwheat and Tares: in general, it is better to have a plentiful crop of a grain of an inferior kind, than a ſmall crop of one of more value. In Beauſſe, and ſeveral other fertile provinces, the lands are divided into three portions: one third part of the lands of a farm are ſowed with Wheat in the beginning of October, on the fallows that have received three or four plowings; another third is ſown with ſoft corn, in ſpring, on the Wheat ſtubbles with one or two plowings; and the remaining third lies in fallow.

About Caen, and in other places, the lands are only divided into two portions; one half yields Wheat, and other is in fallow.

I had ſome acquaintance with the methods of practice in Guienne, and in part of Normandy; and am obliged to M. le Baron de Sournia, Governor of Queribus, for enabling me to give an account of the methods uſed in the neighbourhood of Perpignan, where his eſtate lies.

In this hot climate they ſow their lands in September, and begin to cut Wheat about the 12th of June; ſo that their harveſt is generally finiſhed by Midſummer.

They only divide their lands into two portions; ſo that in one year they ſow Wheat, and the other the land ſhould be at reſt. But on ſuch part of their lands as are moſt valued, they have ſeveral crops in the year of reſt: the lands are impoveriſhed by it, and they are obliged to ſow their Wheat too late, which leſſens the crop. We ſhall mention an inſtance given by M. Sournia.

In land they can water, they ſow Clover immediately after Wheat-harveſt, ſcattering the Clover-ſeed on the ſtubble; they immediately water it, and ſeveral times afterwards during the ſummer; in the winter they feed it with ſheep and lambs. Such as have no flocks ſell their paſture to the mountain-Farmers that have flocks but no winter fodder, their land being covered with ſnow: this paſture fetches a very high price.

In ſpring, when the graſs has been eat-green by the cattle, they water the land: the Clover ſprouts apace, when it is in bloſſom, they mow it, and, making it into hay, put it into the lofts with other kinds of hay.

Immediately after this crop they dung the land, and ſuch as are not fearful of exhauſting it, plow it, and ſow Kidney-beans or ſmall Millet: but as they cannot plow for the Wheat, nor ſow till theſe crops are off the ground, there is not time ſufficient to give the land proper tillage, the ſowing is retarded, and the rich particles of the dung are in part conſumed by theſe crops, when the dung might with more advantage be laid on the land they cannot water. M. de Sournia is by repeated experience convinced that, to have good crops of Wheat, they muſt be content with the crop of Clover, and only ſow Kidney-beans, Millet, &c. in ſmall quantitiss for the uſe of the family.

In Guienne, as well as in the Anjoumois, they take in the year of fallow a crop of Maiz, which impoveriſhes the ground much. The good Huſbandmen alſo think, that in the rich lands which they cannot water, it is beſt in a farm of three hundred acres to be content with having one hundred and fifty acres in Wheat, and to be careful to give proper tillage to the one hundred and fifty acres that ſhould be in fallow, to make them proper for the reception of Wheat. This is alſo the practice in ſome diſtricts in Normandy,

mandy, where the climate being colder and the ſoil more tardy, they have ſcarcely an opportunity of having any crop but Wheat. Nevertheleſs, when the land has been well dunged and tilled for Maiz, as they beſtow three plowings on that plant, there is commonly the next year a very good crop of Wheat.

It is evident that, by dividing a farm that has three hundred acres in tillage into portions, the tenant, during nine years leaſe, will reap one thouſand three hundred and fifty acres of Wheat: whereas, if the land is divided into three portions, it will only amount to nine hundred acres. But, in this laſt caſe, the Farmer has nine hundred acres of ſpring-corn, which being eſtimated at half the value of Wheat, make it juſt equal to one thouſand three hundred and fifty acres of Wheat. It thence follows, that in grazing countries where they plow with oxen, and uſe but few oats, it is moſt advantageous to divide the land into two portions; but that this is not to be done in Farms that are tilled with horſes, ſince the neceſſary purchaſe of Oats would amount to the value of the four hundred and fifty acres of Wheat extraordinary.

SECT. II. *Different Methods of dividing Lands according to the Soil.*

We have lands that yield large crops of Wheat, when they can be properly prepared for it; but they can neither be plowed in very dry nor very wet weather. A Farmer who intends to lay ſixty acres in Wheat, is not ſometimes able to prepare above twenty-five or thirty: his loſs, however, is not conſiderable; for theſe lands which had already received ſome plowings for Wheat, generally yield very large crops of ſpring-corn.

SECT. III. *Two Methods of laying out Lands in Lower Normandy.*

In Normandy, about Bayeux, there are two methods of laying out lands.

In one of theſe methods, 1. They ſow Buck-wheat about the end of June; 2. When the roots and ſtems of this plant are dead and withered, that is about All-ſaints day, they plow and immediately ſow Wheat: thus the Wheat is ſown on a ſingle plowing. It is true theſe lands have been plowed for the

Buck-wheat, and even thoroughly dunged. Thus, as I have ſaid in ſome of my works, plenty of manure can ſupply the place of good tillage, as good tillage can that of manures. 3. After reaping the Wheat, they plow in the ſtubble as ſoon as poſſible, and giving the land a ſecond plowing in February or March, ſow Oats, or, beſtowing one plowing more, lay it in Barley: 4. They plow in the Barley ſtubble in winter, and, after having given one ſpring plowing ſow Peas or Tares: 5. Immediately after this crop of Pulſe is off they turn in the land, that it may receive two plowings before October, to receive Wheat: 6. The following year they ſow Oats, mixing with them ſome Clover, leaving it then in paſture for three or four years. It very proper, according to the nature of the land and the Farmers occaſions, to vary ſucceſſively the ſeeds that are ſowed; but, by the method above related, ſix crops are got in ſix years; two of Wheat, two of Oats, one of Buck-wheat, and one of Peas or Turnips; the field is then left in Clover to be fed for four years.

In the other method, which is called *Varet*, they ſow no Buck-wheat on the land they break up; it is left in fallow, from

February or March, when it is turned up, to October; and in this interval they give it ſeveral plowings to prepare it for Wheat. The crop is generally much finer than when Buck-wheat is ſown. In other reſpects they purſue the method above related.

We ſhall next treat of M. Patullo's method of Huſbandry, which is as follows:

Sect. IV. *M. Patullo's Method of Huſbandry.*

1. The lands ſhould, if poſſible, be turned up in Autumn, that the winter-froſts may mellow the earth, and kill the weeds: 2. In ſpring, as ſoon as the land is a little dried, a ſecond plowing is to be given: 3. Manure proper for the ſoil is to be carried on: 4. A deep third plowing is to be immediately given, and, if neceſſary, the land is to be harrowed to break the clods: 5. In Auguſt a fourth plowing is to be given: 6. In October the Wheat is to be ſowed, and a good crop may be expected: 7. Immediately after harveſt the ſtubble is to be turned in: 8. In March a ſecond plowing is to be given, and Barley ſowed, which, like Oats, is to be cut in Auguſt. 9. Immediately after the Bar-

ley is got in, the ſtubble is to be plowed, and a harrow paſſed over it to break the clods: 10. A ſecond plowing is to be given in September to ſow Wheat. This method, which M. Patullo recommends for rich lands, nearly reſembles the Huſbandry called in Normandy *Varet*.

With reſpect to ſandy, gravelly, and light ſoils, it is ſufficient, ſays M. Patullo, 1. To give them three plowings: after the ſecond, the manure is to be carried on; and, after the third plowing, Wheat is to be ſowed under furrow. 2. Immediately after harveſt, the Stubble muſt be burnt, a ſlight plowing given, and Turnips ſowed.

3. When the Turnips are off, the land muſt have a deep plowing, and white Peas be ſowed.

4. After the Peas are off, the land muſt be plowed, and ſowed with Turnips, as in the preceding year.

5. In the ſpring following, having prepared the land by one or two plowings, Barley is to be ſowed.

Thus there are five crops in three years; one of Wheat, two of Turnips, one of Peas, and one of Barley.

6. After the Barley is got in, the land is to be plowed; it muſt then be harrowed, and in September ſowed with Clover if the ſoil is a little moiſt; and during the winter-froſts the manures are to be carried on, and ſpread on the Clover.

7. In the Autumn of the third year the Clover is to be plowed; a ſecond plowing to be given in ſpring, and the land ſowed with Barley.

8. After the crop of Barley it muſt be twice plowed and ſowed with Wheat.

9. The following year a ſecond crop of Wheat may be had, and ſucceſſive crops of ſoft corn; or the courſe of Huſbandry above-mentioned may be followed; but at at the end of the third year Clover muſt be ſowed; or, according to the nature of the land, other artificial graſſes, conforming to the methods we ſhall lay down under the article of artificial paſtures.

This courſe of Huſbandry does not much differ from that uſed about Bayeux.

SECT. IV. *Uſages in the Angoumois.*

In the Angoumois they have ſeveral methods of parcelling their lands for ſowing.

The lands that are kept in tillage, having had two plowings, are frequently ſowed with Maiz, which in that country they call *Spaniſh Corn.* Whilſt the grain is on the ground they give the land two or three dreſſings by hand to kill the weeds, and another to earth up the ſtems of the corn; and as this manual tillage is more effectual than could have been given with the plow, they look upon the land to be in a condition to receive Wheat. Therefore, when they have cut and carried off the Maiz, they ſow the Wheat, giving the land a ſingle plowing to cover the ſeed.

After the crop of Wheat, ſome, without delay, dung and plow their lands to ſow Maiz, and then Wheat again.

Others, inſtead of Maiz, ſow a mixture of all kinds of grain, as Barley, Oats, Wheat, Peas, &c. which they cut while green to feed their Oxen before the Hay-harveſt; and, as this crop is very early, they immediately dung and plow the land to prepare it for the reception of Maiz the ſpring following, and then Wheat.

Many, inſtead of the above-mentioned fodder, in the ſpring ſucceeding the Wheat-harveſt, ſow Barley or Oats, or a mixture of Barley and

Oats, which, joined with Maiz, makes meal for the poorer ſort of people.

After this ſoft corn is got in, ſome give their land a year's reſt, in which time they beſtow on it a few wretched plowings, ſtirring but half the earth; and others continue to ſow in the courſe we have already related.

But, in light ſoils, they ſow Rye inſtead of Wheat; and in poor lands they prefer Oats to Barley.

The land intended for the Flax is dunged, and very carefully plowed.

When the flax is pulled (in the month of June) the land is immediately plowed and ſowed with Turnips. Theſe are drawn in the Winter for the pot, and for cattle; and in ſpring the tops are cut off whilſt in bloſſom, and given to the oxen. Others, after having plowed the Flax lands, ſcatter a great deal of Maiz on it, which they cut green at the beginning of the winter, to fatten their oxen.

There are in the Angoumois a great many natural paſtures, which they ſeldom break up. They abound in Saintfoin, have much leſs Lucerne, and ſcarcely any Clover. When they break up any of theſe lands they manage them as in the other provinces to prepare them for ſowing.

In countries where they ſow much Hemp, before they pull the Male, or Summer-hemp, which bears no ſeed, they ſcatter Turnip-ſeed on the field; this is covered by the earth that is moved in pulling the Hemp. They ſow again a little more ſeed when they pull the Female or Winter-hemp; and, by this means have two ſeveral crops of Turnips.

In other provinces they ſow Carrot-ſeed with Flax; the Carrots grow but ſlowly with the Flax; but when it is pulled they thrive apace, and are uſed in winter for the pot, and to feed cattle.

When the moſt profitable method of laying out the land is fixed on, and the neceſſary tillage given, the ſeed muſt be choſen and prepared; which is the ſubject of the next Chapter.

* * *

CHAP. V.

Of Seeds.

WHEN the land is prepared by proper plowing, and enriched with a ſufficiency of manure, it is neceſſary, according to the nature of the ſoil and the occaſions of the Owner, to determine what ſort of ſeed is to be ſown, whether Wheat, Rye, Barley, Oats, Buck-wheat, Millet, Maiz, Peas, Beans, Kidney-beans, Tares, Lentils; graſſes for artificial paſtures, as Lucerne, Saintfoin, Clover; or roots, as Turnips, or Carrots; or other plants, by which much money is got in many provinces, as Flax, Hemp, Cole-ſeed, Woad, Weld or Dyers-weed, Teaſil, Tobacco, &c.

But as it is propoſed particularly to mention the culture of moſt of theſe plants, we ſhall in this Chapter only treat of Wheat. We once more adviſe the careful Huſbandman, to be, above all things, particularly attentive to the kind of grain that thrives beſt in his land, and prefer it to all others; as it is much more advantageous, for inſtance, to have large crops of Rye than indifferent ones of Wheat.

Wheat *(frumentum)* is doubtleſs the grain that is moſt proper for making the fineſt bread; but there are ſeveral kinds differing one from the other in quality and fruitfulneſs.

They may be divided into Winter-wheats, which are ſown at the latter end of September or the beginning of October, and are ripe in July or Auguſt of the following year; and into Summer-wheats, which are ſown in March with the ſpring-corn, and are ripe as ſoon as the Winter-wheats.

In both kinds there are ſome bearded, the outward chaff terminating in a long point; *triticum hibernum aut vernum ariſtis longioribus*; and ſome without awns, called Naked Corn, *ariſtis carens.*

I am acquainted with only two ſorts of Summer-wheat, the naked and bearded. We cultivated, however, a very good ſort with awns, which M. Le Comte de la Galliſoniere brought from Spain. The grain of it was ſmall, had ſcarcely any bran, and was very white. It made excellent bread; but it degenerated, for reaſons which I ſhall in due time mention.

With reſpect to the Winter-wheats, there are ſeveral ſorts naked and bearded, chiefly diſtinguiſhed by the colour of the ear or grain, which is white, yellow, red, or grey. But ſome of them are alſo more hardy than others, growing on almoſt any ſoil, and many afford a larger encreaſe than the reſt.

I intended to have made a collection of all the kinds of grain I could meet with; but other avocations having prevented me, I ſhall content myſelf with mentioning thoſe moſt known in our province.

They breed there both ſorts of Summer-wheat; the naked and bearded; the laſt is moſt common. In that part of our eſtate, which is in Beauſſe and its neighbourhood, only naked Wheat is to be met with: in that part which is in Gatinois, on the borders of the foreſt of Orleans, all the Wheats, are bearded. Theſe laſt have large, long, and very broad leaves: in April they look much finer than the naked Wheats. Yet they put forth very few ears, in compariſon of the Wheats of Beauſſe, where, in favourable ſeaſons, the ears ſtand very cloſe together.

It is a very ſingular obſervation, and has been often repeated, that if the naked Wheat that grows in our plains is ſowed in the ſtrong rich lands which we have bordering on the foreſt of Orleans, in three years it becomes bearded, and of the ſame nature with the reſt growing in that diſtrict. The firſt year none of the ears have awns; the ſecond, at leaſt a third of them are bearded; and the third, almoſt all of them. The contrary is the caſe if bearded Wheats are ſown on our lands; they loſe their awns in three or four years.

Does this change proceed from the nature of the ſoil; or is it that the grain which is carried from one place to another, is impregnated by the Wheat, which moſt abounds in the place it was carried to? I believe the laſt to be the eaſe, and could have been more poſitive in this point, but that the experiments I made were infeſted by the birds, which infallibly deſtroy all grain that is ſowed in ſmall quantities.

I had formed a deſign, together with M. Le Comte de la Galiſſoniere, of raiſing all the kinds of Wheat I could procure from the ſeveral provinces of the kingdom, and from abroad, to find out which was moſt profitable to raiſe, and which made the beſt bread. But, as I could not procure any great quantities of theſe ſeeds; when I had cauſed them to be ſeparately ſowed, all was devoured by birds. If, to prevent this inconvenience, I ſowed them near our country Wheats, theſe laſt impregnated the others, which degenerated in a ſhort time. Entire fields ſhould then be ſowed of this foreign corn; and this is too much for a private perſon to attempt.

Our Farmers of Beauſſe had got from Normandy a red-bearded Wheat, which proſpered in their lands, and yielded well; but they have left off growing it, becauſe their horſes would not eat the ſtraw of it, which is large and tough; this would be a great inconvenience in Farms where there are few meadows. We have not, however, entirely abandoned our trials; for this year 1761 we ſow two acres of bearded Wheat, and hope it will ſucceed better than the others did.

I muſt not omit ſaying ſomething of the Smyrna Wheat, called *Triticum ſpicâ multiplici*, becauſe from the main ear lateral ones extend on all ſides, forming often an ear as big as an egg. But this grain is not ſo remarkably fruitful, except it grows in a very rich ſoil; and we have not obſerved that it produced much more than others when we have ſown any quantity of it.

Some kinds of Wheat are certainly leſs nice, with reſpect to the nature of the ſoil than others. A careful Huſbandman ſhould ſhould therefore try which ſort ſucceeds beſt in his land, and ſow it accordingly.

The ſame kind of Wheat will produce larger grains in drained marſhes, and very rich and moiſt ſoils, than dry natural earth. But it is not the largeſt grain that is choſen either for bread or for ſeed. On the contrary, they prefer a ſmall grain, very ripe, heavy, of a fine yellow colour, full, hard to bite, above all things, neither burnt nor ſpotted, and clear from ſeeds of weeds. It muſt not then be imagined that the ſize of the grain depends always on the ſpecies; neither does it conſtantly proceed from the nature of the ſoil: we ſhall ſet this matter in a clearer light.

Large grains are ſometimes found in very ſhort ears; and this is the caſe when, by any accident, the point of the ear is dead. Suppoſe, for inſtance, that in the month of April, the ears begin to be clear of leaves; a ſudden froſt comes, which damages the point of the young ear; this part dies, but the reſt continuing to grow, the grains become large, and well fed as if no accident had happened to the point. In this caſe then the ear is ſhort, contains but few grains; but they are very fine.

This is not the caſe when the ſmallneſs of the ear is owing to the weakneſs of the plant. In a very dry year the plant, for want of nouriſhment, ſhoots but weakly; the leaves, ſtraw, and ears are ſickly. In this caſe the grains are ſmall; and, for the moſt part, the ſame kind of Wheat will yield ſmaller grains in a poor hungry ſoil badly tilled, than in rich land with proper culture.

It ſometimes happens that, in large long ears there are ſmall grains. This cannot be attributed to the barrenneſs of the ſoil, to bad tillage, nor to the weakneſs of the plant, ſince the ſtraw, leaves, and ears, teſtify to the contrary; but this happens when the plants, being very vigorous, are ſurpriſed by ſudden heat, which precipitates their maturity; the grains are then ſmall and ſhrivelled, particularly at the point of the ear, where they are moſt backward.

It is not neceſſary to dwell any longer on the accidental ſize of grains; but we will examine the choice that ſhould be made of ſeed, and what dependance is to be had on the liquors or ſteeps intended to increaſe their fertility.

SECT.

SECT. I. *On the Choice of Seeds.*

It is a well known fact, that in ſome years, the ſame ſort of grain is much ſmaller than in others. When this is the caſe, the Farmers do not ſcruple uſing it for ſeed: they they are only careful to ſow it a little thinner; becauſe the hand of the ſower then contains a greater number of ſeeds; and when the year is favourable to Wheat, theſe ſmall grains often yield large crops.

M. le Chevalier de Laumoi, my kinſman and neighbour in the country, having purpoſely picked one by one, a number of thoſe ſmall poor grains from the points of the ears, and which ſome very improperly ſtile Wheat degenerated into Rye, cauſed them to be ſowed on a bed in his garden; he had them weeded with care, and theſe grains, which were rather thinly ſowed, becauſe a part of them did not come up, yielded for the moſt part from twelve to fifteen ſtalks each. Thus theſe ſmall grains, being thinly ſowed in good ground and carefully weeded, proſpered well.

Neither is this ſurpriſing, as a grain large or ſmall, after having produced roots and ſome leaves, remains empty and entirely uſeleſs,

leſs, with reſpect to the future growth of the plant. If the firſt roots extend themſelves in good earth, if they imbibe thence plenty of nouriſhment, their produce will be as fine as was that of M. deLaumoi's ſmall grains. A large ſeed may, indeed, at firſt produce a ſtrong root, which is an advantage; but if this ſeed is in a bad ſoil, this firſt advance does not laſt long; the plant ſoon becomes leaner and poorer than that of a ſmall ſeed ſown in good earth.

Notwithſtanding M. de Laumoi's experiment and the cuſtom our Farmers have of ſowing ſmall grain, when they happen to have reaped it ſo, I am of opinion that ſuch ſeed as is moſt perfect in its kind ſhould be preferred.

I ſay in its kind; for the Farmers who work the ſtrong lands on the borders of the foreſt of Orleans, and who grow their large bearded Wheat, prefer for ſeed the ſmall grain produced by Champaign country Wheat without awns. For the ſame reaſon, if a Farmer of the Champaign country intends to buy ſeed, he will always prefer the large-bearded Wheat from the borders of the foreſt.

Farmers often buy a part of their ſeed; for the good Huſbandmen do not always ſow their land with ſeed of their own growth: they alſo, by choice, buy *Gleaner's corn*, becauſe the ears being picked one by one, this grain is always free from Weeds and is never ſmutty.

The practice of changing ſeed is confirmed by the cuſtom they have in England, and even in France, of importing their Flax-ſeed from Flanders, or the North; and it is obſerved that, by ſowing this ſeed, they have finer Flax than when they ſow the ſeed of the country itſelf.

Almoſt all the provinces in the kingdom have the ſeed of the Spaniſh Cardoon from Tours. For many years Cauliflower-ſeed was brought from Malta; Melon-ſeed from Italy; Lucerne from Languedoc; and good Huſbandmen are careful to change a part of their ſeed every year.

We think there are reaſons that ſhould engage us to follow this practice.

Some plants are better ſuited to one climate than another. They grow to greater perfection in the climate that is, as one may ſay, natural to them, than in one that is not ſo. A weakly plant bears ſeeds badly nouriſhed;

hence it doubtleſs follows that ſeeds, gathered in a climate that was not adapted to the plant, yield a plant leſs perfect, than ſuch as are gathered in their natural climate, or in one ſuited to their condition.

With all the art we could uſe in raiſing Melons, we could cut them but of very indifferent quality, when compared with thoſe of Italy, where that plant grows almoſt without culture. If we were not careful to ſave the ſeed of our beſt Melons, we ſhould ſoon have none but what were very bad. But, as our beſt Melons are inferior to thoſe of Italy, we may compare our beſt ſeed to the middling ſort of that country. This example is ſufficient to make it evident, that it is moſt profitable to have our ſeeds from the countries the plants thrive beſt in.

In the ſame province, the quality of the land may have the ſame effect on the ſeed as the climate; for plants growing lean and weakly in poor land, they are always fearful leſt the ſeed ſhould partake of the conſtitution of the plant that bore it; and that the produce of it will not be as fine as if it came from plants the moſt perfect of their kind. For this reaſon Farmers get their ſeed from the beſt cultivated ſoils, and from lands that have the character of producing the moſt perfect ſeed. For, tho' it may with truth be ſaid, that the ſtrength of plants depends more on the goodneſs of the ſoil than the ſeed, yet it is certain, that a better crop may be expected from good ſeed than from ſuch as is lean and ſtarved. On this account Farmers reſerve for ſeed the choiceſt grain they have. But, when they buy ſeed at market, they can extend their choice over the whole diſtrict; they are often not content with this, but procure ſeed from very diſtant markets.

Another reaſon may be given that ſhould induce us to change our ſeed: ſome weeds are particularly fond of certain lands, and do not thrive ſo well in others. If a Farmer ſows his own Wheat he encreaſes the weeds that are naturalized to his ſoil; but, in changing his ſeed, the weeds that may be mixed with it not being in their natural earth, will do little injury to the corn. Beſides, when ſeed is bought, it is always choſen as clear as poſſible of weeds.

As the greateſt part of the ſeed that is ſown is taken from the laſt crops, it is neceſſary to ſelect for that uſe what is moſt perfect.

Beſides, care ſhould be taken to pick the great weeds out of the ſheaves, and only half thraſh theſe ſheaves without unbinding them, ſtriking the flail on the end, in order to have the moſt perfect grain free from weeds, which are generally at the foot of the ſheaf.

There is yet a better way, particularly in wet years, when the corn is ſo tender as to be bruiſed by the flail. Then, that this bruiſed grain, which will not grow, may not be loſt, it is beſt to ſtrike it on a barrel, as they do Rye, when the ſtraw is intended to make bands, or be made into ſheaves for tying vines. The thraſher ſtands overagainſt a caſk laid on its belly; he takes the Wheat by handfulls, and raiſing it, ſtrikes the ears on the belly of the caſk, the choiceſt corn drops, free from weeds which remain at the bottom of the ſheaf; and by this method fine ſeed is got. As the ſtraw is not to be ſaved for bands, the threſher throws the handfulls on the floor; and every now and then thraſhes them with a flail to get out the reſt of the corn.

Tho' in wet years corn is not ſo good for keeping, yet I think it very good for ſeed. In the firſt place it ſprouts well; and as dry ſeed muſt imbibe moiſture before it ſprouts, the moiſture which grain has contracted when got in wet, and which ſpoils it for keeping, is favourable for germination: they appear above ground ſooner; this is always an advantage, were it only, that it ſecures it from many animals which eat it, whilſt yet in grain. But, in wet years, great care muſt be taken not to ſow corn that has been heated in the ſtack: ſheaves that are ſtacked whilſt they are wet, will ſometimes heat ſo as to prevent the corn ſprouting.

We muſt alſo avoid ſowing ſprouted grain; for it will either produce a weak ſickly plant, or not come up at all.

In all theſe doubtful caſes, it is beſt to try the ſeed, by ſowing a certain number of grains in a ſpot of good earth. By this little experiment, it will be found whether a ſixth, a fourth, or a third of the ſeed does not come up; and the ſower, according to the quantity that fails, is to ſow the land thicker or thinner.

It is almoſt an univerſal cuſtom with Farmers to take their ſeed-corn from the laſt crop; but we have ſeveral times experienced, and that in extenſive trials, that two year old Wheat comes up very well: only it will be neceſſary to allow a little more ſeed, if, by the experiment, we have above recommended, it is found that ſome of the ſeeds fail. M. de Chateauvieux, who has obſerved, that grain which has not attained a perfect maturity, will ſprout very well, aſſerts, nevertheleſs, that it is better to ſow corn of a year old than that of the laſt crop; particularly when, by the badneſs of the weather, the new corn is got in wet. Some have even aſſerted, that two year old corn was leſs ſubject to mildew than that of the laſt crop; but I do not know that this is proved by any ſufficiently exact experiments. Don le Gendre, Proveditor of the Abbey of St. Martin de Seès, fearing the ſprouted Wheat would not ſucceed, in 1754 cauſed fifty acres of land to be ſowed with old Wheat; this piece was the enſuing harveſt the admiration of the whole country, when all the neighbouring lands which had been ſowed with a new-ſprouted grain, yielded ſcarcely any thing.

Since 1709, when they were obliged for want of new Wheat to ſow their lands with old ſeed, the Farmers of this province have got the better of the prejudice they had, that old corn would not come up. We know by experience, that Wheat kept ten years in the drawer of a bureau, has come up. M. de Chateauvieux having ſowed three quarters of an ounce of corn, that had been kept with care eight years, the ſeed came up tolerably well, and produced largely. M. Peirol has ſowed Wheat ſix years old, and ſeen it ſprout. I adviſe, nevertheleſs, ſuch as are about to uſe old corn, not to fail trying whether the ſeed all comes up; for inſects will ſometimes damage the bud; then ſeed that appears very fine to the eye, will never riſe.

Old ſeed is generally longer before it appears than new; and this, as has already been ſaid, is a great inconvenience.

Tho' we are of opinion, that plants degenerate in a climate, the ſoil of which is not adapted to them, yet are we far from thinking that, in degenerating, they change their ſpecies; that Wheat turns to Rye; Oats to Darnel; or that Bear, a kind of Barley which they grow in the Limoſin, degenerates into Oats, &c. This opinion is ſufficiently adopted to merit a ſerious refutation.

M. le Chevalier de Laumoi, being willing to know for a certainty, whether the Summer-wheat degenerated into Barley, as he had been often told; and reflecting that none of that grain could be bought without ſome mixture of Barley, after the ſame manner as Wheat has generally ſome Rye in it, cauſed enough of this Summer-wheat to be picked grain by grain as would ſow an arpent of land; and he cauſed another arpent to be ſowed with unpicked ſeed, as it was bought at the market. He was not ſurpriſed to find Barley, at harveſt-time, in the arpent that was ſowed, with unpicked ſeed. As Barley was ſowed, there, it muſt of courſe be found amongſt the crop; but in the other, where he was aſſured no Barley was ſowed, he did not find a ſingle head; and, tho' the ears were all carefully examined, there was not a grain of Barley to be found. If then ſome Rye is found in Wheat, and ſome Barley in Summer-wheat, it is becauſe the ſeeds are ſowed at the ſame time of the year in lands equally tilled, and they are gathered at the ſame time and put into the ſame barn; and all this is more than ſufficient to produce the mixture above-mentioned. M. Bonnet of Geneva has made many experiments on theſe pretended tranſmutations; but without having ever ſeen any thing of the kind.

It has, it is true, been declared in print, that Oats being mowed when they begin to ſhew their heads, produce a different grain; but this is a very defective obſervation. Oats are very commonly cropped, whilſt green, by cattle on the road ſide; but who ever perceived this change of ſpecies? When facts are examined with attention, the wonderful generally ſubſides.

A very particular care ſhould be taken, that the ſeed-corn is not ſmutty. Certain preparations are even ſometimes uſed; as mixing lime with the ſeed, to preſerve it from mildew, and from being burnt. In general, the prepartion of ſeed is ſerviceable, as a preventive againſt the ſeveral diſtempers of Wheat, as will in due time be explained; but theſe preparations are very different from the fructifying liquors, or ſteeps, of which we are about to treat.

SECT. II. *On fructifying Liquors, or Steeps.*

The marvellous is well-reliſhed, particularly when it promiſes us very uſeful matters; nothing could be of more advantage than to have good crops without dunging the land, and with very ſlight tillage; this is what the Abbé de Vallemont propoſed. By means of his fructifying liquors, the whole attention was to be confined to the preparation of the ſeed; and when it was once impregnated with a certain liquor which had, as he ſaid, the property of unfolding the buds, a good crop was to be expected. Nothing could be more improbable. It is well known that a ſeed contains a plant in miniature, in that part called the bud; that the reſt is a ſtock of food to ſupport the young plant, till it has put forth roots enough to draw its nouriſhment from the earth: no ſooner do the roots extend but the ſeed is exhauſted, and there remains nothing but the huſk, which thenceforward is uſeleſs: what effect then can fructifying liquors have? They may, perhaps, make the nutritive ſubſtance of the ſeed more proper for the ſupport of the young plant, which, by that means may, till it has put forth roots be more vigorous; but when once this young plant has put forth its roots, when once it ceaſes to be ſupported by the lobes of the ſeed, of what uſe can the fructifying liquors be? Is there the leaſt probability that any of it is to be found at the diſtance of four or five inches from the plant, in the earth to which the roots are extended, and from which they extract their nouriſhment? However void of all probability this idea may be, De Vallemont's liquor was eſteemed a wonderful diſcovery: it was looked upon as a magnet capable of attracting from the atmoſphere certain principles which probably never exiſted there; and a number of receipts for making fructifying liquors have been invented. The different books of Agriculture, the Maiſon Ruſtique, ſwarm with them: they are there repreſented as wonders in Nature. The deſire the public had to find theſe virtues real, procured them a good reception; and experiments badly conducted propagated the error ſtill farther.

They took a certain quantity of ſeed; they impregnated it with theſe pretended fructifying liquors; they ſowed theſe ſeeds, one by one, in a kitchen-garden; they ſaw a wonderful encreaſe, and thought it all owing to the liquor. I was myſelf deceived by ſuch trials; but when I extended them to pieces of three or four acres, this wonderful encreaſe was no longer viſible, and I began to have but little dependence on theſe boaſted liquors. But, having ſeen a ſingle grain of Barley produce, without any preparation, two hundred and thirty ſtalks; and being alſo informed, that another grain of Barley had produced in England one hundred and fifty ears, I thence concluded, that theſe wonderful encreaſes, ſo much boaſted of in the Maiſons Ruſtiques, and attributed to liquors that unfolded the buds, were to be attributed to the quality of the ſoil, to good tillage, and to the grains being ſo diſtant one from the other, as to be able to extend their roots very far, and collect a great quantity of nouriſhment. I had then recourſe to new experiments, which confirmed me in my opinion.

I cauſed ſome good Wheat to be ſteeped in the juice of dung, to which I had added lixivial ſalts, nitre, and ſal ammoniac; this grain I ſowed in two beds of a kitchen-garden, well dug with the ſpade; but in one of theſe beds it was ſowed very thick, and in the other very thin. At the ſame time I ſowed two other-like beds with the ſame ſeed unſteeped, after the ſame manner the ſteeped Wheat was ſowed; one of the beds was ſowed very thick, the other very thin.

At harveſt-time the beds that had been ſowed with the ſteeped Wheat, ſo exactly reſembled the others, that it was not poſſible to diſtinguiſh them, without having recourſe to the regiſter of my experiments.

A gentleman in our neighbourhood was inclined to try the the infuſions ſo much recommended in the Maiſon Ruſtique; and, as the authors of that book aſſert, that one plowing is ſufficient on land that has been in Wheat, and that a third of the ſeed may be ſaved, this gentleman, to follow word for word their directions, cauſed one plowing to be given to a field that had been in Wheat, and immediately ſowed it, uſing only two thirds of the uſual quantity of ſeed: yet, notwithſtanding the aſſurances of all theſe Authors who have copied one from the other, this Wheat turned out ſo indifferent, that it was not worth reaping.

In the Political State of England, Vol. VIII. anno 1758, it is recorded that a grain of Wheat which grew in an Onion-bed, and which had received no preparation, yielded five thouſand ſix hundred ſeeds. After relating this intereſting fact, the Author remarks, "that we ſhould not thence, form "any opinion of the natural fruitfulneſs of a "country, nor of the methods of Huſbandry "that are in uſe; theſe aſtoniſhing productions are to be attributed to the plant's "ſtanding ſingle and in a rich mould; that "all we can infer from thence, is, that the

" new Huſbandry, bearing the neareſt reſem-
" blance to that which has produced ſuch a
" wonderful phænomenon, it probably ought
" to add to our crops; that it is, at leaſt,
" moſt likely that Huſbandmen would find
" their account in ſowing leſs ſeed than
" they do."

Tho' it is very well proved by experiment, that good tillage and manures contribute, more than any fructifying liquors, to the encreaſe of crops, yet ſeveral public-ſpirited people have publiſhed, ſome the good effects of certain fructifying liquors, whilſt others have given the receipts on which they had moſt reliance.

M. de la Jutais has publiſhed a very ſmall work, called, The true Philoſophers Stone, according to which, the way to procure an admirable fructifying liquor is to melt nitre in an iron veſſel: when it is hot enough to burn whatever is thrown on it, a ſmall quantity of the ſeed intended to be ſowed is ſprinkled on the nitre: for inſtance, if a fructifying liquor is wanted for Wheat, a little Wheat is ſprinkled on the nitre; if for Turnips, a little of that ſeed, &c. Theſe ſeeds burn, and when they are reduced to a a coal, they melt with the nitre: the fructifying mixture is then made, and it is only neceſſary to diſſolve the nitre in water. What effect has this operation? None at all; except that in this fructifying liquor there is a great deal of nitre, and ſome fixed nitre or alkaline ſalt; whether this nitre be fixed with Wheat, or Barley, or Turnips, or charcoal, all Chemiſts agree, that the reſult is the ſame, and that this ſame liquor may be made by mixing a little alkaline ſalt with a ſtrong ſolution of nitre. It remains to ſhew what effect it will have on vegetables. But to make theſe experiments properly, by way of compariſon, two fields of the ſame nature muſt be ſowed, one with the prepared ſeed, the other with the ſeed only limed as is uſual, care being had to ſow the ſame quantity in each field: for the ſingle circumſtance of leſſening the quantity of ſeed, may, in years when the corn branches much in good land, encreaſe the crop: many have been deceived by not having proper attention to this circumſtance, as well as to others I have mentioned above. The following experiments were properly made.

M. Delu, having with the greateſt precaution, for the third time, tried M. de la Jutai's Eſſence, concluded it to be of no uſe.

M. Peirol, Secretary to the Intendant of Auvergne, who was prejudiced in favour of theſe fructifying liquors, after many experiments executed with the greateſt care, has concluded, that the prodigies of Vegetation, related by ſo many Authors, are chiefly to be attributed to the good quality of the earth, to proper tillage, and to the plants being ſo diſtant one from the other as to be able to collect a great quantity of nouriſhment. For this reaſon the plants which he watered with theſe liquors at different times, became extremely vigorous.

Being willing myſelf to be ſatisfied of the virtue of a pretended fructifying liquor, publiſhed by M. Robineau, in a pamphlet which has been publiſhed over the kingdom by means of the Intendants, I pitched on a piece of ground intended for Wheat, and cauſed it to be divided into three equal parts: one was ſowed in the common way, and the ſeed being only limed, produced on an arpent of land one hundred and ninety-two ſheaves, which yielded five ſeptiers †.

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† A Septier is twelve Boiſſeau, or French buſhels, and each buſhel is a trifle more than a peck and a quart Engliſh meaſure. The French buſhel for Oats is juſt double the ſize of the common French buſhel.

Another diviſion was ſowed in the common way, only diminiſhing the quantity of ſeed two fifths: this produced one hundred and ſixty-eight ſheaves, which yielded four ſeptiers and a half.

The third diviſion was ſowed with the ſame quantity of ſeed as the ſecond; but prepared in the manner directed by M. Robineau: this produced one hundred and fifty-ſix ſheaves, which yielded four ſeptiers and a half.

Whence it follows, that neither the liquor nor the juice of the dung were of any advantage to the crop.

Mr. Robineau's liquor, on being diſtilled by a very ſlow fire, yields a ſmall quantity of aqua vitæ; what remains in the matraſs yields a great deal of ſaltpetre, and the watery reſiduum contains a little alkaline ſalt. This approaches very near to what may be obtained from the Sieur de la Jutai's liquor.

M. Vandusfel has alſo tried M. Robineau's fructifying liquor; which produced no other viſible effect, but that the corn was leſs ſmutty in that field than in thoſe where the ſeed had received no preparation. But ſeed which he impregnated with an infuſion of dung, aſhes, and lime, was totally exempt from ſmut.

M. Donat, one of my moſt zealous correſpondents, informed me of his having made numberleſs trials of ſome proceſſes, which, if the propoſers of them are to be believed, ſhould effect wonders; but he ingenuouſly confeſſes, that he found them of no uſe but to amuſe a few curious particulars, who make only confined experiments, and grudge no expence. The Authors who writ on this ſubject after L'Abeé de Vallemont boldly aſſerted, that ſeed prepared with nitre, other ſalts, &c. may be indifferently ſowed on all ſorts of land, good, middling, or bad, well or ill plowed, and reſted or not: in all theſe caſes, they venture to ſay that a crop ten times as great as in the common methods may be depended on. Tho' M. Donat had no great reliance on theſe fine promiſes he was determined, nevertheleſs, to give them a trial with all the care poſſible. He cauſed then to be ſowed a great quantity of land, good and bad, well and ill plowed, &c. he made himſelf the lixivium with the utmoſt care; he was on the ſpot when the land was ſowing; in fine, he took care that no circumſtance was omitted; but, notwithſtanding all his attention, the crops were far from being ſo good as the inventors of theſe ſecrets had confidently promiſed they would be.

The good lands, well tilled, yield fine and good Wheat; but the quantity was not extraordinary, and the only advantage conſiſted in ſaving half the ſeed; and this advantage is ſomething: but we ſhall ſoon make it appear, that it is often proper to leſſen the quantity of ſeed, independent of any fructifying liquor whatever.

The lands that were indifferent in their nature, or indifferently tilled, or ſuch as had not been reſted, yielded him very little corn: and the bad lands abſolutely none at all. Theſe experiments, which M. Donat repeated, confirmed him in the opinion, that the ſureſt way of having good crops is to till the land well. The ſeed being choſen, as we have directed, it muſt be in ſome manner prepared to prevent its being burnt: we ſhall treat of this in a particular Chapter: but ſomething muſt firſt be ſaid on the Method of Sowing.

CHAP. VI.

Of Sowing.

THE ſowing of lands has ſo immediate an influence over the ſucceſs of the crop, that Huſbandmen cannot be too attentive in this article. 1. The land muſt be ſowed at a proper ſeaſon; 2. It muſt be done with preciſion; 3. The ſeed muſt be put at a proper depth; 4. Neither too much nor too little muſt be uſed; And 5. It muſt be ſpread in ſuch a manner, as that there ſhall be betwixt each plant a ſpace proportioned to the quantity of food it requires. This ſhall be treated of in five ſeparate Articles

SECT. I. *Of the Seaſon and Weather proper for Sowing.*

Farmers remark, that the corn which is earlieſt ſowed is in general ſooneſt ripe. It thence follows that, tho' it may be an advantage to accelerate the ſowing of land when the proper ſeaſon is come and the weather is favourable, there are, however, ſome reaſons why all the land ſhould not be ſowed at the ſame time; for if the corn was all to ripen together at harveſt, ſome would ſhed before it could be got in. But it is in fact always beſt to ſow the land as faſt as poſſible, when the weather ſuits.

Whether it is beſt to ſow early or late is a matter of enquiry. It is certain no preciſe time can be fixed, as the time ſhould vary in the ſeveral provinces, according to their latitude. We muſt, on this account, be content to make general obſervations, from which particular perſons may make the inferences that will beſt ſuit them.

As it is always an advantage to forward the crops, and as experience convinces us that ſeed ſown early is ſomewhat ſooner ripe than what is later ſown, it ſhould follow that early ſowing was beſt. Beſides, the corn has the ſeverity of the winter to encounter. The froſt is very trying to it; ſo that it is neceſſary they ſhould have put forth roots and leaves enough before winter comes on, to be able to bear the hard froſts. This ſhould be an inducement to early ſowing, particularly in the northern countries, where the froſts are more ſevere than in the ſouthern.

Finally, it has been imagined that, in the years wherein corn is ſubject to blights, ſuch ſeed as has been late ſowed is moſt ſubject to them: we ſhall notice this in the ſequel.

If it was poſſible to foreſee that the autumn would be cold, there would be little riſque in early ſowing; but as the weather is not to be gueſſed at, early ſowing may occaſion diſappointments: for if land is ſowed early, and a moiſt mild autumn ſucceeds, the corn gets ſo forward as to be blighted before winter, and this is a very conſiderable prejudice: if the winter is ever ſo little ſevere, the ſhoots the corn has made before that time periſhes; and ſome have even thought that the plants, exhauſted by their firſt efforts, make weaker ſhoots in the ſpring; but this is not yet quite clear. But if the ſeed ſhould have been ſowed ſo early as for the ſtalks of the corn to begin to appear, ſevere froſts would very much weaken them; whereas, if they had had only their firſt leaves, they would not have been injured. M. de Châteauvieux ſays, that the proper ſeed-time at Geneva is the end of Auguſt and the whole month of September. In Beauſſe and Gatinois we ſow Wheat the beginning of October: in Limouſin and Angoumois at the end of that month: and about Bourdeaux in December.

With reſpect to circumſtances favourable to ſowing, it is very properly obſerved, that the land ſhould be a little moiſt, without being wet enough to knead. I am of opinion too, that if it was poſſible to foreſee what the weather would be, the ſowing ſhould be a little delayed till there had fallen a good deal of rain, and that the land was a little dried; or the ſeed ſhould be ſowed when the land is very dry, ſome days before rain, becauſe, in very dry weather, the ſeed lying very long in the earth, a great deal of it never comes up. But, as it is impoſſible to know how long the dry weather will laſt, a Farmer that has much land in tillage begins ſowing as ſoon as the ſeaſon comes on. One thing to be conſidered is, that he who ſows the beginning of September may wait long for rain; but he who ſows in October is ſeldom long without it: thus the firſt may, in caſe of drought, delay his ſowing; but the other will do well to begin, notwithſtanding the drought, and depend on the Huſbandmen's principle, who ſay, that Wheat ſhould be ſowed when the land is duſty, becauſe the rain is at hand; but ſpring-corn, when it is very wet, becauſe in April are often great heats. When land has been well tilled, and is not too much diſpoſed

to

to retain wet, it may almoſt always be ſowed in a proper manner: this is the caſe of our Champaign lands. But in the clayey lands, on the borders of the foreſt of Orleans, it is ſometimes ſo difficult to ſow Wheat, that a Farmer who intends to ſow ſixty arpents with that grain, is ſometimes obliged to be content with half the number. This is not, however, any great loſs to him, becauſe, by ſowing ſpring-corn in the lands prepared for Wheats, he has very large crops.

The following obſervation may, in ſome ſort comfort ſuch as can with difficulty ſow their lands in due time. I remember one year, when ſowing was almoſt done in our Champaign lands, a hard froſt came on which laſted three weeks, and the ſeed that was in the ground did not come up under a month. The winter was cold, and the corn was very weakly in the ſpring; one particular piece which was ſowed late did not come up till the end of February: the harveſt, nevertheleſs, was very good, and the corn thick enough.

It is not improper to mention that M. Delu, having ſowed ſome Summer-wheat in autumn, it proved as ſtrong as the Winter-corn, and yielded a good crop: probably, becauſe

cauſe the froſt was not ſevere enough to kill the ſeed. I am ſorry I have not repeated the experiment.

SECT. II. *Different Methods of Sowing.*

The moſt common method is to ſow by hand, and by cuſtom the ſowers ſpread the ſeed tolerably even. In kindly land, they cover it with a common harrow; and by this method they have the advantage of having their ſowing ſoon done; but as this inſtrument cannot properly cover the ſeed when there are clods and ſtones, they ſometimes uſe rolling harrows, which conſiſt only of two large rollers armed with iron ſpikes. We ſhall ſpeak of them when we treat of the inſtruments of Huſbandry.

It is thought that by rolling this inſtrument over the fallows when they are ſowed, the ſpikes break the clods, ſtir the ſurface of the earth, and cover the ſeed. This harrow will not do in ſtiff poachy lands; in them the ſeed muſt be covered with the plow, which takes up much time. This plowing is always very ſlight and ſuperficial, that the ſeed may not be buried too deep, or it would never come up: but if the land is ever ſo little wet, this plowing kneads it, makes it poachy, and greatly damages it, and the ſeed is buried at irregular depths.

I ſhall ſay ſomething of the ſeveral methods of ſowing.

There are two ways of ſowing lands that are plowed flat. When theſe lands have received the laſt plowing, their ſurface conſiſts of very ſmall ridges, of which A B (Pl. 2. Fig. 5.) repreſents the ſection.

In kindly lands that are not apt to be poachy, the ſower takes a certain quantity of ſeed, which he carries with him in a kind of apron, called a Seed-bag; and, taking the corn by handfuls, he ſcatters it about him, in ſuch a manner, that the ſeed may be equally ſpread; this requires great addreſs and ſkill; for, at the ſame time that he gives his arm a circular motion to caſt the ſeed with ſtrength, he ſhould open his hand by little and little, that it may not fall in a heap, but be ſcattered, and ſpread itſelf ſomething like a ſhower of rain. It is remarkable, that the good ſowers have got the cuſtom of taking their handfuls of corn ſo exactly alike, that they will ſow any quantity on an acre, as it is to be thicker or thinner. But be it as it may, this ſeed ſpread by handfuls and with ſtrength, rebounds on the land, it falls into the loweſt ſpots, and the greateſt part of the ſeed is collected into the furrows *c c c c*. When the field is ſowed, to cover the ſeed, they harrow it from A to B, and from B to A till the field is level, and the little furrows *c c c* are no longer ſeen. The earth of the ridges *d d* being caſt into the furrows *c c*, the land lies flat as it appears at C D, Fig. 6. and the ſeed is under ground as it appears under the letters *e e e e*; this cauſes the corn to come up in rows, as at *g g g* in the ſection of the field E F, Fig. 7. This is one of the beſt methods of ſowing land; it is uſed when the land is plowed flat, or even in broad lands, provided the earth is kindly enough to admit the uſe of the harrow. Yet, if one cloſely examines a field newly harrowed, a great quantity of ſeed may be perceived on the ſurface, which becomes the food of birds.

When lands are too ſtiff, cloddy, or ſtoney to admit the harrow, they ſpread the ſeed in the manner above deſcribed; but they cover it with the plow, that is, they ſplit with a plow that goes ſhallow the little ridges or eminences *d d d* to cover the ſeed that is in the furrows *c c c*. It is not to be imagined

they

they can regularly ſplit all the eminencies; therefore they make a general light plowing; but it always turns out that ſome of the ſeed is covered with too great a depth of earth, and a great deal not covered at all.

Another method is uſed, which they call Sowing under Furrow, in poachy lands, and in very light ſoils where they apprehend the wind's uncovering the ſeed; or, that the ſun will parch the roots of the ſeed that ſhoots too near the ſurface. To do this, they lay the ſeed in the new-made furrow, and it is immediately covered by the next furrow; by this means the ſeed is placed beneath the earth that is ſtirred by the plowing, and next the hard ſoil.

In moſt parts where they cover the ſeed with the plow, they ſpread only half or a third part of the ſeed, and caſt the remainder behind the plow in the furrow juſt made. This method conſumes a great quantity of ſeed; and that caſt in the furrows is too deeply buried, whilſt that ſowed by the broad caſt is not covered enough.

In Auvergne they very commonly ſow in the above-mentioned manner: but M. Nonand has farther informed me, that they ſometimes ſow *full furrows*, and, at other times, *in atlernate furrows.*

They call it ſowing *full furrows* when, in the laſt plowing, they caſt the ſeed into every furrow that the ſhare cuts, and this ſeed is covered in making the next furrow; but when they ſow *in alternate furrows* they caſt the ſeed in one furrow, then make another in which they put no ſeed; the next has ſeed caſt into it, inſomuch, that in the whole extent of the field there is alternately a furrow ſowed and another not ſowed; this gives the corn more room to extend its roots, collect food, and throw out a number of branches. Farther, as in April they give the Wheat a ſlight tillage, by howing betwixt the rows, this greatly reſembles our method; and, according to M. Nonand, it is the beſt in uſe.

It is evident that, by the methods, we have deſcribed the ſeed is very irregularly diſtributed: in every cavity fifteen or twenty ſeeds are collected, whilſt, in other parts, there is no ſeed at all: that which is covered by too great a depth of earth never comes up, whilſt many ſeeds which remain on the ſurface, or too near it, are eat by the birds, or parched by the ſun: whence proceeds a great conſumption of ſeed, which is a total loſs. Theſe reaſons firſt cauſed *Drills* to be thought of. M. Tull invented one, but it was too complicated, and apt to bruiſe part of the ſeed. M. Chateauvieux contrived a very good one, but of too high a price for huſbandmen. I have recommended one more ſimple and leſs expenſive; we ſhall in the ſequel ſpeak of it. M. de la Levrie has alſo contrived one. We ſhall deſcribe theſe ſeveral inſtruments in a particular Chapter.

SECT. III. *At what Depth the Seed ſhould be ſowed.*

All plants ſhould not be ſowed at the ſame depth. To be certain of this, I made a trench of twelve feet long, at one end it was two feet deep, at the other it had no depth at all: I ſowed different ſeeds at the bottom of this trench; and, having cauſed the earth to be replaced, I obſerved, 1. That ſcarcely any ſeed comes up when buried above nine inches deep; 2. That ſome ſeeds came up very well at ſix inches deep; 3. That other ſeeds never came up, if they were placed deeper than one or two inches. Theſe experiments convinced me, that the ſame ſort of ſeed may be laid deeper in light lands than in ſtrong ſoils; and that ſeeds which were placed too deep to come up in a dry year, would yet come up if the year was warm and wet. Some other experiments have proved to me, that when ſeeds are at too great a depth in the ground, they will keep ten or twenty years without alteration; inſomuch that if, after that ſpace of time, by removing the earth, they are brought to the ſurface, they ſprout very well, and produce a plant of their ſpecies.

It is therefore evident, that every kind of ſeed ſhould be ſowed at a depth that ſuits it; and the moſt certain way is to find out this depth by trials, by making, with the kind of ſeed intended to be ſowed, the experiment abovementioned. When the ſeed is come up, it will be known at what depth each plant ſhould be ſowed; and the *Drill* may be ſet in ſuch a manner as to bury the ſeed at the preciſe depth required.

From what we have obſerved, we can ſay, that in our Champaign lands Wheat ſhould be placed two inches and a half, or three inches under the ſurface; but in our clayey lands, on the borders of the foreſt of Orleans, it is ſcarcely poſſible to prevent ſome of the ſeed being choaked, when they are cloddy, which is very often; for I have frequently ſeen ſeed ſprouted, which being covered by a clod, has periſhed, without being able to reach the ſurface.

With regard to Pulſe, it may be laid down as a general maxim, that ſmall ſeeds ſhould be placed nearer the ſurface than ſuch as are larger.

SECT. IV. *What Quantity of Seed ſhould be uſed.*

In ſowing by hand, it often happens that one handful is larger than another; that the ſeed being ſmaller, the ſower's hand contains a larger quantity. If the field is full of clods and rough, the greateſt part of the ſeed is collected in the bottoms, very little remaining on the eminencies: whence it follows, that the ſeed is unequally diſtributed.

Beſides, in common ſowing, particularly when it is covered by the plow, too large a quantity of ſeed muſt be uſed; becauſe, as it is placed at different depths, that which is too deep never comes up; and another part, which was not at all covered, is eat by the birds.

Theſe inconveniences are avoided by uſing *Drills*. For, 1. They make the rills at the required diſtance, and nearly at the depth found to ſuit the plant to be ſowed; 2. As the *Drills* fill all the rills, no ſeed remains uncovered; 3. Laſtly, the drills diſcharge into every rill the preciſe quantity of ſeed thought proper.

By the help of Drills, the ſeed is placed in ſuch an exact manner in the ground, that we may well ſuppoſe it will all come up, unleſs it ſhould happen to be deſtroyed by inſects.

But, as Drills only diſcharge the neceſſary quantity of ſeed, we muſt be certain that every grain is in a capacity of ſprouting and coming up; for it often happens that part of the ſeed is bad. As the quality is not to be known by the eye, it is neceſſary to be convinced by experience, ſowing fifty or one hundred ſeeds promiſcuouſly taken, but exactly counted; and when they are come up, by the number of ſtalks it will be viſible whether a tenth, a ſixth, or a third part has failed, and the quantity of ſeed to be ſowed on the land is to be encreaſed in proportion. In waſhing the ſeed in lime-water what ſwims may be ſkimmed off; and, by this means, great part of the bad ſeed is taken away.

SECT.

SECT. V. *Of the Diſtance to be preſerved betwixt the Seeds.*

It is evident that, with the help of the *Drill*, by placing the ſeed at a proper depth, and covering it with a ſufficient thickneſs of earth, much ſeed may be ſaved: this is proved by many experiments executed with great care. But, ſuppoſing the ſeed thus well covered, at what diſtance muſt the plants be placed one from the other, to make fine ſhoots, and not to rob one another of their food? This point of Agriculture merits more attention than may at firſt be imagined. The Peaſants think very abſurdly, that the more ſeed they put into the ground the larger will be their crop. Yet there is ſcarcely any body but what has ſeen ſeeds of Wheat, Barley, or Oats ſtanding by themſelves, which, being in a capacity of extending their roots on all ſides, have produced twelve, fifteen, twenty and thirty ears a-piece, inſtead of two or three to each ſeed, as they do when ſowed thick in a field. It has been ſeen that plants of Lucerne or Saintfoin, ſtanding ſingle, have grown almoſt to the ſize of a ſhrub. Every one may have remarked,

marked, that an inſulated tree grows much faſter than one of the ſame kind in a crowd; and that a hedge will yield more faggots than a ſtripe of the ſame width taken out of a wood. All theſe obſervations, and many others I could mention, to prove that large crops may be produced by a little ſeed, placing, for inſtance, the ſeeds eight inches one from the other; and this will be literally true, if the ſoil was very good, and the ſeeds all came up; if none of them were eat by inſects, and if proper care was taken by frequent tillage, to encreaſe the vigour of the plants, and deſtroy the weeds that would rob them of their food. I could make what I have ſaid very evident by numberleſs experiments; but I ſhall content myſelf with the relation of one only, made by M. Conilh, Counſellor of the Parliament of Bourdeaux.

The ſoil was neither ſtrong nor light, but of a good quality; it is ſituated on the ſpot which they call, *Betwixt the two ſeas*. On every ſtitch were ſowed four rows at eight inches diſtance, and the ſame diſtance was obſerved betwixt the ſeeds in the rows. When the ſeed was come up, care was taken to ſupply the deficiencies of ſuch ſeeds as failed. From December, when it was ſowed, to Harveſt-time, which is in June, it could be but once hoed: but it was twice weeded. At the end of June the ſtraw was large and ſtrong, and bore ears five, ſix, and ſeven inches long; twenty and thirty ſtalks were produced from a ſingle ſeed. The little ſtalks on the ſides were not deſtitute of grain. The whole field appeared to be as full of ears as the adjoining field, which was ſowed nearly with the uſual quantity of ſeed. The crop yielded three hundred and ſix or three hundred and ſeven grains for one. This experiment which was repeated in three different places by M. Conilh, is an evident proof, that a very ſmall quantity of ſeed will produce a good crop, provided the land is good, the roots have room to extend, and the young plants are ſupplied with food by tillage.

But, in large concerns, it is impoſſible to be exact in all theſe points: ſome ſeeds never ſprout, and others are deſtroyed by birds or inſects. An allowance of ſeed muſt then be made for theſe accidents; and M. de Chateauvieux has often ſaid, that in the firſt years his crops were leſſened by ſowing too little ſeed. But we muſt not paſs from one extreme to the other, and ſow a third part more ſeed than is neceſſary. Our Peaſants allow ten or twelve buſhels (French) for an arpent, and ſix or ſeven would be ſufficient. We ſhould be very glad to fix a general rule, in this reſpect; but it is impoſſible; we can but eſtabliſh maxims for every one to be guided by.

Were it poſſible to be certain, that the weather in the ſpring would be favourable to the branching of the corn, much ſeed might be ſaved; but, as nothing can be done in that reſpect, we muſt content ourſelves to ſow ſeed in proportion to the goodneſs of the land. The more the land is diſpoſed to vegetation, and the better it has been mended and plowed, ſo much the more do the plants branch, and, of courſe, leſs ſeed is wanted. Such as pretend that the richer the land is the more plants it can feed, and that conſequently more ſeed muſt be ſowed, are deceived, not reflecting that a ſeed placed in a good ſoil branches much; whereas, that which is in a poor ſoil can only produce one, two, or three ears. If, in this caſe, the ſeed was put at eight inches diſtance, as M. Conilh did, in ſuch a field the ears would be very ſcattering, and the weeds, which thrive in theſe bad ſoils, would ſoon get the upper hand of the corn, and choak it.

On the contrary, if the ſoil is good, every ſeed produces many ears, and the field will be well filled. This is confirmed by an experiment made by a widow lady, who commonly lives at Bourdeaux: this experiment was made in a country, called *Betwixt the two Seas*; being, in fact, betwixt two great rivers, the Garonne and the Dordogne.

This lady, having obſerved that the labourers ſowed the corn too thick, peremptorily ordered, that on her land they ſhould only ſow one fourth of a Boiſſeau * of Wheat on a Journal (about an Engliſh acre) of land, inſtead of a whole Boiſſeau, which they were accuſtomed to ſow.

The quantity of ſeed being thus fixed, her corn always turned out finer than her neighbours, and her crops yielded twenty, twenty-five, and thirty for one.

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* The Boiſſeau, or buſhel of that province weighs near one hundred and forty pound (French). In the juriſdiction of the Parliament of Paris the arpent contains always one hundred ſquare perches; but, according to the place, the perch is eighteen, twenty, or twenty-two feet long. The ſquare perch of eighteen feet aſide contains three hundred and twenty-four ſquare feet, or nine ſquare fathoms: thus this arpent, which is in uſe about Paris, contains nine hundred ſquare fathoms. About Pethiviers the perch is twenty-two feet long.

The Journal is the ſum of ſixteen lattes, or laths multiplied by thirty-two; the latte, or lath is ſeven feet, and the foot thirteen royal inches; the journal of Bourdeaux contains rather more than eight hundred and thirty-eight ſquare fathoms.

This experiment proves, that in good land where corn branches much, it is a loſs to ſow too much ſeed; this agrees perfectly with a principle of Huſbandry that ought to be generally attended to, viz. that more ſeeds and plants are to be put in a bad ſoil than a good one. For inſtance, in bad land, a peach-tree will at moſt take up twelve feet of an eſpalier; on the contrary, in a very good ſoil I have known one cover thirty-five.

If in ordinary lands the crop is generally ſix for one, it muſt not be imagined, when we ſay this lady had an encreaſe of thirty to one, the crop of every Journal was encreaſed in the proportion of thirty to ſix, tho' the proportion of thirty to one exiſts betwixt the quantity of grain ſowed and what was got in; for this lady having ſowed leſs ſeed, the proportional produce of her land, compared to her neighbours, ſhould be much leſs.

Theſe experiments, tho' very proper to eſtabliſh the principle we have advanced, were made without the help of any *drill*. Tho' we have ſaid but little on the advantages accruing from the uſe of theſe inſtruments, yet it muſt be allowed, that by depoſiting the ſeed at a proper depth, and diſtributing the quantity judged neceſſary, they muſt, of courſe, enable us to make a ſtill greater ſaving of ſeed; and this has been proved by many experiments to be found in the Treatiſe of Huſbandry, particularly the Sixth Volume.

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CHAP. VII.

Of Weeds and Inſects.

WHEN the corn is ſowed, it remains expoſed to injury from weeds, inſects, and birds. Theſe accidents we muſt endeavour to guard againſt.

SECT I. *Of extirpating Weeds.*

The Farmers call every thing that grows in the fields, except what they mean to cultivate, by the name of *Weeds*.

They rob the crop of a great part of the ſubſtance of the earth, which they exhauſt as much as the corn does. Sometimes they get the upper-hand, and encreaſe ſo faſt, that a field does not ſeem as if it had been ever ſowed with corn.

The weeds that do moſt damage, are,

1. Fennel-flower, or Cockle, (*Nigella arvenſis cornuta, Pin.*) its ſeed is black, and leſs than that of Wheat; it ſomewhat reſembles blighted Wheat; it is with difficulty ſeparated from the corn, and makes bread black.

2. The Campion, a ſort of Lychnis, (*Lychnis ſegetum major, Pin.*) which riſes very high. The ſeed is black, and the ſieves cannot ſeparate it from Wheat.

3. Fox-tail, or Cow-wheat, (*Melampyrum purpuraſcente coma, Pin.*) the ſeed is ſomewhat like Wheat; it makes bread bitter.

4. The wild Poppy, or Corn-roſe, (*Papaver erraticum majus, &c. Pin.*) the ſeed is very ſmall; it encreaſes ſometimes ſo prodigiouſly as to choak the Wheat.

5. The wild Fitch, (*Vicia ſegetum*) of ſeveral kinds, which cover the corn when it is laid, prevent its riſing, and cauſe it to rot.

6. Dog's Graſs, (*Gramen*) ſeveral kinds.

7. Colt's Foot, (*Tuſſilago vulgaris, Pin.*) encreaſes by its ſeed and creeping roots, and even by the fragments of roots that are cut in plowing the land.

8. Melilot, (*Melilotus officinarum, &c. Pin.*) this gives bread a bad ſmell.

9. Thiſtles, (*Carduus*) of ſeveral kinds.

10. Dwarf Elder, or Danewort, (*Sambucus humilis, ſive Ebulus, Pin.*)

11. The Corn-bluebottle, (*Cyanus ſegetum, Pin.*) and many other plants, which greatly exhauſt the land.

To prevent the encreaſe of theſe weeds they muſt be killed before their ſeeds ripen.

They are not to be deſtroyed by leaving the lands uncultivated; for their ſeeds will remain ſound for many years in the land. If Saintfoin is ſowed on a field that abounds with Poppies, after the ſecond year ſcarcely a Poppy will appear. But if, at the end of nine years the Saintfoin is plowed up, the Poppies will often make their appearance; and this can be attributed to no cauſe but their ſeeds remaining ſound all that time in the earth; for very little could come from the adjacent lands, or be brought in dung.

Another experiment. I cauſed the earth to be thrown out of a ditch that had been filled up fifteen or twenty years before. The earth was ſpread on a plowed field; and ſeveral plants appeared which were not to be found in the reſt of the field. They muſt then have been produced from ſeed which kept undamaged in the earth during the fifteen or twenty years that the ditch continued filled up.

For this reaſon fallows ſhould be carefully plowed as often as the weeds appear, when the land begins to look green. A plowing at this time deſtroys the weeds that are come up, and freſh ſeeds are brought near the ſurface, which ſprout in their turn; the fallow again looks green, and another plowing is beſtowed on it; but in lands that have been badly tilled, and are full of ſeeds of weeds, it is neceſſary to give five plowings.

This is chiefly with regard to annuals: with reſpect to the perennials, in order to deſtroy them, the land muſt be plowed when it is very dry in the heat of ſummer. In wet weather, plowing ſometimes increaſes inſtead of deſtroying them: this is particularly obſerved of Couch Graſs.

In lands that are very weedy, they are ſometimes obliged to ſow Peas, which, not being long in the ground, are no great hindrance to frequent plowings; or, what are ſtill better, they plant Potatoes, Beans, Maiz, or other plants which admit of the earth being tilled when they are on the land. This repeated tillage is very ſerviceable in deſtroying weeds.

Lime alſo deſtroys a great number of weeds; and ſome ſay Marl has the ſame property.

But there are ſome kind of plants, ſuch as wild Oats and Fox-tail, which muſt remain a year or two in the ground before they will come up, and no care or cultivation will have any effect on them.

It is evident that plowing fallows is ſo far from deſtroying theſe kinds of plants, that it, perhaps, rather diſpoſes them at a more proper depth to ſprout, when the time of their germination is come.

The Farmers have not thought of any better method of deſtroying theſe plants than by tranſpoſing their crops; that is, ſowing Oats the year that Wheat ſhould have been ſowed; and they find that by this means ſome plants are deſtroyed, which, appearing only once in three years, are never ſeen but with Wheat.

But the Farmer loſes a crop, and has ſtill many weeds to deſtroy; this obliges him to weed his corn. There are two ſeveral ways of doing this.

Some women are placed in a row, and being provided with each a *Weeding-hook*, which is a little ſharp hook (Pl. 2. Fig. 8.) with a wooden handle three or four feet long, they cut up all the weeds in their way; ſuch as Thiſtles, wild Poppies, and Blue-bottles. If theſe plants are young, the weeders do not ſee them; and in this caſe, when they grow larger, the land muſt be again weeded.

But the ſmall plants, which are not leſs prejudicial, ſuch as the wild Fitch, the wild Oat, Darnel, Fennel-flower, Knot-graſs, Reſt-harrow, Fox-tail, the ſeveral ſorts of Bindweed, *(Convolvulus)* and all the ſmall Poppies, remain in the field. Beſides, in cutting up the weeds, it is ſcarcely poſſible to avoid cutting the corn; and Thiſtles, and other biennial plants, puſh out, one, two, three, or four ſtems from their roots, inſtead of one, by which means the evil is encreaſed.

The other method of cleaning corn is, by hand-weeding it. But this is not much in uſe amongſt Farmers, being too expenſive. In the Vine countries women are glad to weed the corn for fodder for their cows. By this means the Farmers, it is true, do not want weeding; yet they pull up a great deal of corn, and do other conſiderable damage; particularly in wet weather, by treading on the corn, and dragging their ſacks after them.

The moſt certain way of deſtroying weeds, is to continue the tillage whilſt the corn is on the land. This is done by manual labour, in the neighbourhood of Clermont, on lands where they only ſow every other furrow. It would be of great ſervice if an inſtrument could be invented that an aſs might draw betwixt the rows of corn: I could alſo wiſh ſome practicable method could be diſcovered to deſtroy Heath, Fern, Danewort, Colts-foot, &c. Pigeons dung, ſpread thick in paſtures, deſtroys ruſhes: with turf-aſhes I have killed wild Thyme, and good graſs has come in its ſtead.

Is it impoſſible to find manures which, by killing the weeds, may benefit the corn? It ſhould be tried whether by pulling up the Danewort, Fern, &c. at certain times of the year, the roots of thoſe pernicious plants may not be deſtroyed.

SECT. II. *Methods of guarding againſt the Ravages of Inſects and Birds.*

Corn from the time of ſowing to Harveſt, is ſucceſſively expoſed to various accidents, occaſioned by different animals. I do not mean the damage done by the field-mice, which eat the ſeed, and even the plants; by the crows, which pull up the corn, in ſeeking for their ſeed with their long beaks; and by the hares and rabbits, which eat the blades, and ſo impoveriſh the young plants that ſhould ſucceſſively produce new leaves, that they branch but little, and produce very weakly ears.

We ſhall only remark that pigeons, which have not a beak ſtrong enough to take the ſeed out of the ground, and which do not eat the blades, are ſupported by the ſeed that was uncovered; but this ſeed would have infallibly become the prey of ſome other animals, or have been parched by the ſun.

As ſoon as the corn is come up the pigeons, which can then only feed on the ſeeds of weeds, leſſen greatly the number of them; and whoever will take the trouble of calculating what quantity of ſeed is neceſſary to ſupport the pigeons of a well-ſtocked Dove-houſe, muſt be ſenſible that they greatly leſſen the number of weeds.

The partridges are not more hurtful than pigeons, becauſe they never ſcratch; they feed only on the blades of the corn, conſequently do it no damage, unleſs there ſhould happen to be too great a quantity of game in a diſtrict where there is little corn.

The ſparrows do a great deal more damage in Harveſt-time, by the prodigious quantity of grain they devour: they often deſtroy a third part, or half of a crop in detached fields, or ſuch as happen to border on woods, or to be in the neighbourhood of houſes. They have fruſtrated all the experiments I meant to make on ſmall plots, or in places at a diſtance from Wheat-fields. The damage done by birds is not ſo viſible in a piece of four or fiwe hundred ares, but a crop on one or two inſulated acres is deſtroyed by them. Bearded Wheat, and Rye eſpecially, is not ſo ſubject to be damaged by birds: this is a neceſſary piece of knowledge; for, on ſuch detached ſpots, it is much better to have a crop of Rye than to be deprived of half the Wheat that has been ſowed, and cultivated with ſo much care.

It is well known that birds do great damage, particularly to hemp and ſuch kind of plants; becauſe the ſeeds coming out of the ground with their huſks, the birds taking them for whole ſeeds, carry them off in their beaks, by that means pulling up ſo many young plants. M. des Cougnets ſays, that by infuſing the ſeed in tan-water it becomes diſguſtful to the birds, at leaſt for a week. If this fact was well eſtabliſhed, it might often be of uſe: I have not tried it.

But the damage done by animals is not what we in this place mean chiefly to treat of; we only mention it curſorily: it is time to notice the damage done by inſects. The ſmall ſlugs, in ſome lands, deſtroy many plants of Wheat.

I have obſerved worms of the nature of thoſe which turn to beetles, which inſinuate themſelves into the main root of Oats: they devour all the inſide, and always work upwards: when the internal leaves are eat, the plants die.

I ſuſpect this to be the ſame inſect that deſtroys the Wheat in the territory of Geneva. M. de Chateauvieux wrote me on this ſubject what follows: "Our Wheats, in this "month of May, 1755, have been ſubject "to an accident, from which the grain cul-"tivated by the New Huſbandry is not ex-"empt. A number of white worms have "been found on it, which, after a time, turn "to a cheſnut colour; they place themſelves "betwixt the leaves and gnaw the ſtalk;

" they are commonly ſound betwixt the firſt
" joint and the root: the ſtalks on which
" they fix are immediately at a ſtand; they
" grow yellow and wither. The ſame acci-
" dent happened in 1732: theſe inſects ap-
" peared about the middle of May, and did
" ſo much damage that the crops were ſcarce-
" ly worth any thing."

Small inſects, like Vine-fretters, often attack the roots of Pulſe in kitchen-gardens; they grow yellow by degrees, and, at length, die. M. Tillet ſays, he has found the ſame kind of inſect fixed to the roots of Wheat.

M. de Reaumur, Tillet, and myſelf have obſerved very ſmall caterpillars, which are hatched in the ears of Wheat; and M. Tillet and myſelf intend, at another opportunity, to ſpeak particularly of that inſect which, in ſome provinces, entirely deſtroys the harveſt. I have, long ago, obſerved and delineated ſome little inſects, many of which are of a very lively carmine, others black; they are found in great numbers in the ears of Wheat. I am apt to believe that theſe inſects, which are called *Staphylins,* feed on a kind of honey-dew, which they find in the ears when green. As M. Tillet was immediately inclined to think them capable of doing great damage to corn, he obſerved with attention all their changes, and has given the Natural Hiſtory of them in the Memorials, which were judged worthy of the premium given by the academy of Bourdeaux, and which were printed in 1755.

Many inſects fix themſelves to grain whilſt it is growing, but without doing it any ſenſible damage. M. Tull ſays, that when Wheat is attacked by certain inſects, which he does not particularly enough deſcribe to be known, it is perceived by black ſpots on the ſtraw, and he imagines theſe ſpots to be their excrements.

After the grain is well filled, inſects attacking the ſtraw, do no damage. For this reaſon the forward Wheats are leſs hurt by inſects than ſuch as are more backward; and as the Wheat that is earlieſt ſowed, is commonly ſooneſt ripe, it follows, that in the above reſpect, early ſowing is of ſome benefit.

It is ſaid, that inſects do not commonly attack the white-bearded Wheat, the ſtraw of which is only hollow at bottom, the reſt being full of pith. On this ſuppoſition, that kind of grain might be preferred for lands that are ſubject to have the ſtraw attacked by inſects.

ſects. But as we are not expoſed to this inconvenience, I cannot ſpeak from experience.

M. Navarre mentions an expedient to preſerve the roots and young ſhoots of corn from worms. This is ſaid to have been tried with ſucceſs in Perigord; however, it wants confirmation: it is to put near the land that is ſowed a heap of dung, about two waggon-loads; for there muſt be enough to preſerve the internal heat: the worms immediately reſort thither; and if this dung-heap is opened in March, a great quantity will be found of the worms called in Perigord *Mulots* or *Grillets*; in Patois *Trauque-courge*, which in French ſignifies *Perce-citrouille*, (Gourd Piercer): they have a great number of feet, and their head is armed with two ſcales, which cut like ſciſſars; it is with theſe kind of horns that they cut the roots and ſhoots of plants. It is not however, certain, whether this dung attracts all the inſects in the neighbourhood of it; or whether it does not rather favour the propagation of that inſect.

As the diſtempers of grain merit particular attention, they will be the ſubject of the next Book.

BOOK

ELEMENTS

OF

AGRICULTURE.

BOOK III.

Of the Diſtempers of Grain.

I Could have treated of the diſtempers of Grain in the preceding book, as well as of the remedies that may be made uſe of to guard againſt many of them; but as this part of Agriculture appeared to me to be of conſequence enough to be diſcuſſed at large, and with attention, I have dedicated to it an entire book, in which I propoſe to examine into the nature of one of theſe fatal diſtempers to which, in the provinces where Agriculture is encouraged, they have given the names of *Nielle*, *Nubli*, *Charbon*, *Carie*, *Boſſe*, *Pourri*, (in Engliſh *Smut*); I ſhall alſo ſay ſomething of that which they call *Ergot*, *Grains rouilles*, (Mildewed corn) *Coulés*, (Empty ears) *Retraits*, *Echaudés*, (Parched and ſhriveled corn)

corn) *Glacés*, (Glazed corn) *Avortés ou ſteriles*, (Abortive or ricketty corn); and I ſhall conclude with ſome remarks on *Blés verſés* (Laid corn.)

CHAP. I.

Of the Diſtempers which make Corn black.

IT muſt not appear ſurpriſing that many have confounded the Smut, *(La nielle)* properly ſo called, with Burnt Grain, *(Le Charbon)*. For, 1. The ſmutty and burnt grain are both met with in the ſame fields. 2. When the grain is much infected with the ſmut, a great many burnt ears are generally found: theſe two diſtempers very commonly come together. 3. Theſe two diſtempers attack ſeveral kinds of grain, the ſubſtance of which is farinaceous. 4. In both diſtempers, the farinaceous ſubſtance is converted into a powder more or leſs black, and of a bad ſmell. Theſe diſtempers have, nevertheleſs, diſtinct characters, which ſhould diſtinguiſh them one from the other: we ſhall therefore treat of them ſeparately, in two ſeparate Articles.

ARTICLE I.

Of the Smut, properly ſo called.

There are three points to be obſerved; the characters of the Smut; the cauſes of it; and the means of preventing it.

SECT. I. *Characters of the Smut.*

Since 1751, we have obſerved in the Smut, properly ſo called, the following characters.

1. This diſtemper entirely conſumes the bud and ſubſtance of the grain.

2. It does not only affect the ear, but the whole plant is in ſome meaſure affected when it has got to a great height.

3. When a plant of Wheat is attacked, it is very rare to find an ear on any of the branches exempt from it.

4. In March and April, by carefully opening the ſheath that covers the ear, and by examining the little ear which was not then above two lines in length, and was near the root, I have perceived this embryo already black, and attacked with this diſtemper: perhaps the other plants might have been infected later.

5. When the ear comes out of the cover, which the leaves form for it, it appears ſmall and lean; the coverings of the grain are ſo altered, that the black duſt appears thro' them; and thenceforward, inſtead of the grain, nothing is to be found but a black ſtinking duſt, without ſubſtance. As the particles of this duſt have little coheſion, and the coverings are deſtroyed, it is eaſily carried away by the wind, or waſhed off by the rain; ſo that nothing is generally houſed but the ſkeletons of ears; if any of the duſt remains, it is taken off in the ſifting, and I have not found it contagious like that of burnt grain.

M. Tillet has alſo obſerved, that corrupted ears are often found in the ſheath, tho' the ſheath, which appears green and well-conditioned, has no ſigns of a decay. The upper part of the ſtalk of ſmutty plants is ſeldom ſtraight at about half an inch beneath the ear. On preſſing the ſtalk in this ſpot, it reſiſts, and ſcarcely yields to the finger. On cutting the ſtalk two or three lines beneath the ear, it proves almoſt entirely full of pith; ſo that a very ſmall aperture is to be perceive ved at the heart, whereas in ſound plants this aperture is large. M. Tillet has hence concluded, that ſmutty plants are choaked up at the top of the ſtem.

Bearded Wheats are as ſubject to ſmut as thoſe that have no awns. But neither M. Tillet nor myſelf have found any ears of Rye ſmutty.

SECT. II. *Enquiry into the Cauſes of Smut.*

The Smut cannot, as has been hitherto imagined, proceed from the grains not being impregnated, ſince it affects and deſtroys the organs that diſtinguiſh the ſexes of plants long before the time of impregnating.

It can neither be attributed to the wet hanging on the ears, to fogs, nor the heat of the ſun; ſince we have ſeen ears ſmutty long before they were diſengaged from the coverings afforded them by the leaves, which ſtill continue green, if the diſtemper is not got to any great height.

Theſe ſame obſervations abſolutely overturn the opinions of ſuch as think that the cauſe of the ſmut is to be found in the grain already formed, but as yet of a milky ſubſtance.

It has been pretended that the dampneſs of the ſoil will occaſion ſmut; but it is not perceived that corn is more ſmutty in the bottoms of fields than in the parts that lay higher; beſides, why ſhould one diſtempered plant be found amongſt many that are healthy? Yet, as it appears that grain is more ſubject to ſmut in wet, than in dry years, it is poſſible that, tho' wet is no immediate cauſe of ſmut, it may be favourable to the progreſs of the diſtemper.

Some Naturaliſts have aſcribed this diſtemper to inſects. If I cannot abſolutely contradict this, I can, at leaſt, aſſert that, being at firſt of that opinion, all the reſearches I could make to eſtabliſh its reality were of no effect. I have, it is true, been ſhewed ſome *Staphylins*, and other inſects that were on ſmutty ears; yet, as I found the like on thoſe that were healthy, I believe, with M. Tillet, that theſe inſects are in no reſpect the cauſe of this diſtemper. We are ſenſible that the corn-caterpillar deſtroys the farina, yet it does not cauſe the ſmut. Many flies depoſit their eggs in theſe ſeeds; worms proceed from them and gnaw the ſeed; but we do not obſerve that they occaſion any thing like the ſmut. M. Hales, being willing to try whether grain bruiſed with the flail became ſmutty, choſe a certain number of ſeeds of different ſizes, and bruiſed them with a hammer; this ſeed ſprouted, and bore ears that were not ſmutty. This experiment, made by ſo able a Naturaliſt,

raliſt, ſubverted in this manner an opinion that had been formed on the cauſe of this diſtemper.

The dung of pigeons and ſheep have by ſome been thought to cauſe ſmut; but without reaſon. We have large dove-houſes, the dung of which is ſpread on our Wheat-lands, where our ſheep's dung is alſo laid, and we even fold our ſheep there; yet it is not obſerved that theſe fields are more ſubject to ſmut than others. This opinion is therefore void of all proof.

M. Wolf imagined that ſmut was occaſioned by the unnatural form of the embrio: but M. Aimen has refuted this opinion, by demonſtrating, that in certain plants the male flower is attacked by the ſmut; and theſe flowers have no embrio.

M. Aimen has very judiciouſly obſerved, that the ſmut cannot be owing to any defect in the ſap, as all the parts of the plants, excepting the ear, appear healthy, and there are plants perennial in their roots, which ſeem very vigorous; yet is their ſeed every year ſmutty.

This ſame Naturaliſt, who has made ſome very uſeful reſearches into the cauſe of the ſmut, properly ſo called, ſays, that this diſtemper ariſes from an ulcer which, in the firſt place, attacks the ſtamina of the ſeed, and afterterwards infects the different parts of the flower. But the remote cauſe of this ulcer will, perhaps, be required. To diſcover this cauſe, M. Aimen examined ſeveral grains of Barley with a magnifying-glaſs; ſome were larger than others; many were hard, others yielded to the preſſure of the nail: ſome were of a deep, others of a light colour; many were oblong, ſome rounder; their huſks were cracked in ſeveral places; whereas in a natural ſtate this part is ſmooth and even: finally in ſome he perceived black ſpots, and thro' the magnifying glaſs theſe ſpots appeared to be covered with mould. Theſe grains were carefully ſorted, laid in little heaps, and ſowed a part, but in the ſame land. All the grains that were mouldy produced ſmutty ears: the parched and ſhrivelled grains, and ſuch as had been attacked by inſects, either did not come up at all, or was not ſmutty. He then took ſome ſound and healthy grains; he ſowed them, and ſome time afterwards took them up to examine them with the glaſs; ſome of them he found mouldy, and, putting them again into the ground, they produced ſmutty ears.

M. Aimen, without aſſerting, that there is no other cauſe of ſmut, concluded from the experiments I have mentioned, that mouldineſs is one of the cauſes of the Smut.

It is not eaſy to conceive that this mouldineſs, or, if you will, this kind of moſs, is capable of cauſing this diſtemper; for as ſoon as the grain has ſprouted, and formed its plant, the whole ſubſtance of the ſeed is exhauſted. Whether the huſk rots or not ſeems to be of little conſequence to the plant, which no longer depends for ſubſiſtence on the ſeed that had hitherto ſupported it. It is eaſily conceived that mouldineſs may either kill a plant, or make it weakly. But it is not ſo apparent how this mouldineſs can affect the organs of fructification only, and totally deſtroy them, without any other parts of the ſame plant being viſibly affected; and this, tho' the plants ſhould even be perennial. As to the reſt, M. Aimen relates facts; and, in ſome meaſure, to account for them, one might conjecture on a ſuppoſition that the growth of plants is only an unfolding of their parts; that the organs of fructification, which exiſted tho' imperceptibly in the ſeed, were affected with mouldineſs before the grain was put into the ground. But let us keep to well-obſerved facts: it is of much more importance to collect them than to be in haſte to explain them by conjectures, which hitherto have been little founded on probability.

SECT. III. *Methods of guarding againſt this Diſtemper.*

To prevent this diſtemper M. Aimen recommends that the fineſt and ripeſt grain ſhould be choſen for ſeed; that it be thraſhed without delay, and immediately limed, either to prevent its becoming mouldy, or to deſtroy the mould, if already formed. According to this principle, the lye recommended by M. Tillet ſhould be equally ſerviceable in preventing the ſmut, and preſerving the ears from being burnt. We ſhall make no addition to M. Aimen's advice, not having obſerved ſo much the nature of ſmut as of the Charbon, or burnt ears. As this laſt diſtemper is much more terrible than the other, it has chiefly engaged our attention. According to ſome obſervations made by M. Tillet, it does not appear that the black duſt of the ſmut, properly ſo called, is contagious: and we ſhould ſpeak more deciſively in this matter, could we have collected a ſufficient quantity of this black duſt; but, as we have already ſaid, there is little to be found in the barns, on account of its being before carried away by the wind and rain. We recommend it to the lovers of Agriculture to make freſh trials, in order to find whether ſmut is really contagious; but we warn them not to confound the Smut, properly ſo called, with the Charbon or burnt ears: this has led many Naturaliſts into errors.

ARTICLE II.

Of the Charbon, or Burnt Grain.

This diſtemper of corn is confounded by almoſt every writer on the ſubject with the Smut, properly ſo called: it is, nevertheleſs, very different, and much more dangerous. The Smut, properly ſo called, occaſions the total loſs of the diſtempered ears; but as the black duſt is very fine, and the particles of it have no coheſion, the wind and rain carry it off, ſo that ſcarcely any thing is houſed in the barn but the ſtraw, which is not infectious, and does very little damage to the flour. The Charbon, or burnt grain, is, on the contrary, often laid in the granary with that which is ſound, to which it communicates a contagious diſtemper, and alſo darkens the flour, and gives it a bad ſmell.

SECT. I. *Characters of the Charbon.*

The characters of this diſtemper are, 1. The Plants that produce burnt ears are ſtrong and vigorous.

2. The infected ears are not at firſt diſtinguiſhable from thoſe that are healthy; but when they are paſt their bloom, they appear of a deep green colour, approaching to blue; they afterwards become whitiſh, and are then eaſily known. As this change of colour is effected by the ſun, when a number of white ears have been ſuddenly perceived in looking over a Wheat-field, the ſun's heat has been often thought to cauſe this diſtemper, or a fog preceding that heat.

3. Tho' all the ears produced from one grain are commonly infected, yet M. Tillet, Aimen, and myſelf, have met with ſound ears on plants that had produced others which were infected. We have even found ſome ears, part of which only were viciated, and finally ſome grains encloſing partly a white flour, the remainder black duſt.

4. In burnt ears the chaff, or outward coat, was commonly ſound, with this ſingle difference, that when the ears were near ripe, it appeared more withered and dry than in the healthy ears.

5. The bran which immediately encloſed the grain is not deſtroyed, as it is in the Smut, properly ſo called; but has conſiſtence enough for the grain to preſerve nearly its natural form, with a whitiſh look.

6. The burnt grains are ſhorter, rounder, and lighter than ſuch as are uninfected: they are ſometimes larger, ſometimes ſmaller. The furrow which runs the length of a grain of Wheat is ſometimes totally effaced, at others is viſible: the piſtils at the extremity of the grains are dried up.

7. The bud of burnt grains is not viſible.

8. Till the blooming ſeaſon, there is very little difference betwixt the burnt grain and that which is healthy: they are only a little more ſwelled. But, in the blooming ſeaſon, the infected ears aſſume a bluiſh colour; the chaff is more or leſs ſpecked with ſmall white ſpots: the grains are of a deeper green, and larger than in a ſtate of Nature; and, as long as they preſerve that colour, they adhere ſtrongly to the chaff. The diſtemper has often attacked very young ears

whilſt yet encloſed in the ſheath. The ſtamina on the ſides of the grain are then dried up and ſickly; the embryo in part takes the deep green colour above-mentioned; the infected ears have not the conſiſtence of thoſe that are healthy; in the ſame meaſure the diſtemper advances, the chaff becomes dry and whitiſh.

9. The grains have ſome degree of firmneſs. On opening them, which may eaſily be done with the nail, there appears an unctuous, dark, brown, ſtinking ſubſtance, not at all reſembling the light duſt of ſmutty ears; the duſt of burnt grain has ſome coheſion, and thro' a microſcope appears to conſiſt of larger particles than that of the ſmutty ears.

10. Some time before the blooming ſeaſon the grains appear to be filled with a whitiſh ſubſtance, a little burnt towards the bottom, and this colour extends by degrees over the whole ear: the grain then appears divided, as it were, into equal quarters by furrows; which diſappear as the grain encreaſes in ſize.

11. By what has been ſaid, it is evident that Smut infects corn much ſooner than the *Charbon*.

12. Grains that are much burnt are evidently incapable of ſprouting. But I have

had ſome ſound grains taken from an ear greatly burnt, which, in a kitchen-garden, have produced very ſtrong plants; and tho' the birds diſturbed my experiment, it appeared to me that there were ſome ſound ears amongſt many more that were infected.

13. A part of the burnt grain is bruiſed by the flail, and their black duſt is ſcattered over the ſound grain; this unctuous duſt chiefly ſticks to the hairy extremity of the grain near the bud; it there forms a black ſpot. Corn ſo affected is called *Spotted Grain*: many of the grains which eſcape the flail remain entire, on account of their lightneſs; a great deal is ſeparated by throwing, but the ſpotted grain remains as well as many that are burnt; and this is enough to darken the flour, and give it a bad taſte.

14. To remedy this inconvenience, and make the beſt bread, they paſs the corn thro' drum-ſieves (*cribles à tambour*) made of pierced iron plates, like the graters with which they raſp Tobacco; the corn is then waſhed, and all the light grains that ſwim ſkimmed off, which are moſtly burnt. The water takes off the ſpots, which are but ſuperficial; for if a ſpotted grain is wiped, the ſpot immediately diſappears.

SECT.

SECT. II. *Of the Cauſe of the Charbon.*

With reſpect to the cauſe of this diſtemper, I confeſs we are hitherto as much at a loſs as in the caſe of Smut. Some have attributed it to dung; others to fogs; many to the heat of the ſun; ſome to inſects; others to the moiſture of the land; and not a few to the ſeed not being ripe: but theſe opinions are confuted by good obſervations, and by experiments very carefully made. We refer to what has been ſaid of Smut.

It may ſeem improbable that a mere ſuperficial duſt, that only ſticks to the bran, without penetrating the grain, ſhould be ſo contagious as to infect all the grain it touches, with a diſtemper; what is more ſurpriſing is, that it ſhould injure the organs of fructification only. Yet however improbable this may appear, the experiments made by M. Tillet put it paſt a doubt; they ſhew that the Farmers are not without reaſon cautious in avoiding to ſow ſpotted grain.

As it would take up too much room to mention, at large, all the experiments made by M. Tillet, which are to be found in the papers publiſhed by him on that ſubject, I ſhall content myſelf with relating the reſult of theſe experiments, and the inferences this able Naturaliſt draws from them.

Several writers having mentioned dung as the immediate cauſe of this diſtemper, and others having aſſerted that it was hereditary, all M. Tillet's experiments were calculated to clear up theſe two points: he was at the ſame time in hopes, by means of the ſame experiments, of finding ſome method of guarding againſt this terrible diſtemper.

1. The ſeveral kinds of dung had no viſible effect in producing burnt grain. The infected ſeed produced as much burnt grain in the ground that was not dunged as in that which was. He did not find that dung had any effect either in favour of, or againſt the diſtemper.

2. Dung made of the ſtraw of infected grain, did not ſeem to communicate the diſtemper; but the infected ſtraw unrotted ſeemed to communicate it. Yet the effect was moſt viſible when the duſt of burnt ears was mixed with the earth.

3. All grain naturally ſpotted, whether it grew on the land, or was brought from another place, bearded Wheat, Summer-wheat, and Wheat without awns, produced a great deal of burnt grain.

4. Picked

4. Picked Wheat taken from the fineſt ears, and carefully ſelected grain by grain, that none of it might be infected, being ſowed, ſome in dunged, and the reſt in undunged beds, without having received any preparation, yielded little or no burnt grain.

5. Some of this ſame picked Wheat being ſprinkled with the duſt of burnt grain, produced as many diſtempered ears as that which was naturally ſpotted.

6. The picked Wheat, being prepared with lime and a ſolution of the ſea-ſalt, yielded ſtill fewer infected ears than when unprepared.

7. There were ſtill fewer from what was prepared with lime and nitre.

8. Early or late ſowing ſeemed to be a matter of indifference.

9. It appears by M. Tillet's experiments, ſeveral times repeated, that the duſt of burnt ears is contagious, ſince ſound Wheat ſprinkled with it, or ſowed in rills in which that duſt had been put, produced a great number of infected ears. He alſo found that this duſt, tho' expoſed to a ſtrong heat, as of ſixty degrees, is ſtill contagious, unleſs it is abſolutely burnt by the fire when it has not that effect. Tho' it is kept for years, its infectious quality continues as ſtrong as ever.

10. Some Farmers waſh the ſacks in which they put their ſeed. And it appears by M. Tillet's experiments, that they are in the right; for if the ſacks had any of the duſt on them, it would certainly infect ſome of the ſeed corn.

11. M. Tillet thinks he has obſerved, that the infected plants are more ſuſceptible of injury from froſt than others.

If this is the caſe, hard froſts muſt be ſerviceable, ſince by deſtroying the infected plants, they would have the ſame effect, as if ſuch plants had all been pulled up. The land being cleared of theſe uſeleſs plants, would be better able to ſupply ſuch as are ſound with nouriſhment, and the crop would be exempt from infected ears, which are a great hurt to it.

12. The black duſt ſo contagious, is not ſo to Rye or Bear; but the duſt of Darnel is pernicious to Wheat.

13. Smyrna Wheat is leſs ſubject to this diſtemper than other grain; but Summer-wheat is greatly injured by it.

SECT. III. *Methods of guarding againſt this Diſtemper.*

It muſt be allowed that the knowledge which has been acquired of the cauſe of this diſtemper, has put the curious obſervers in a train of finding proper preſervatives. In fact, as the duſt of burnt grain infects all the grain it touches, it is probable that every method ſhould be deemed efficacious, that is capable of taking away this duſt, provided the virus has not from its firſt contact affected the interior part of the ſeed intended to be ſowed. In this caſe the ſeveral ſieves which we have recommended in the treatiſe of preſervation of corn, and the waſhings with fair water, which in many places is uſed on ſpotted grain, may be mentioned as efficacious preſervatives, as well as lime-water which our Farmers uſe, the ſtrong brine uſed in ſome provinces of France, and the ſolution of Arſenic, of which ſome perſons have made ſuch a ſecret: all theſe preparations ſhould be of ſervice; and, according to M. Tillet's experiments, they are ſo: yet they are often inſufficient. This point, therefore, merited to be cleared up by particular experiments, and with all neceſſary care. M. Tillet ſet about it with ſpirit, and the following are the inferences that may be drawn.

1. The effect of the black duſt on the ſeed is only ſuperficial till it is put into the earth, not at all affecting the interior parts.

2. Therefore every means that can tend to clear them of the duſt, muſt be of ſervice to keep them healthy, and free from the diſtemper.

3. Grain perfectly free from this, and from rottenneſs, will yield no diſtempered plants.

4. Grain blackened with this infectious duſt, may be made healthy by clearing it of ſuch duſt.

5. Sifting ſeed, and waſhing it in ſeveral waters, leſſen, it is true, the effects of the contagion; but this is not ſufficient, as many infected plants will be produced, tho' the ſeed was waſhed in ſeveral waters.

6. Lime, which is more efficacious than water, is not always enough ſo. I ſhall obſerve, on this occaſion, that ſeed was formerly limed in a manner different from what it is now. The ſeed was then put into baſkets, which were plunged into lime-water very hot. The ſeed was ſtirred in the baſkets, and all that ſwam on the water was taken

out with a cullender; by this means they got rid of the infected grain; and the good ſeed was better cleaned, than by only throwing, as they do now, lime-water on a heap of ſeed, which is then ſtirred with a ſhovel, or by only mixing the ſeed with the ſlacked lime reduced to powder.

One of our Farmers, a careful man, being obliged one year to ſow ſpotted ſeed, he limed it by immerſion, in the manner above deſcribed; and the year following had no burnt grain.

Some experiments made in the country of Caux, by M. de Goufreville have been publiſhed; they evince the good effects of lime uſed in the manner we have mentioned. And what is ſtill a farther confirmation of this is, that whenever our Farmers ſow ſeed that has not been limed, their fields are amazingly infected.

7. It is a good precaution to waſh ſpotted grain in ſeveral waters; but it ſhould be ſoaked in brine, and this brine ſhould be abſorbed by lime, by immerſion, as we have deſcribed.

8. A ſtrong brine of ſea-ſalt is very good, and may be employed to great advantage in countries where ſalt is a merchandize.

9. One part of nitre to nine parts water is more efficacious than ſea-ſalt; this, therefore, ſhould be uſed where nitrous earths abound.

10. Strong alkaline lyes are ſtill better; ſalt wort, pot-aſh, aſhes of tartar, lyes of common aſhes much impregnated with ſalt and human urine, or cows urine, alkaliſed by putrefaction: of theſe various articles ſuch may be choſen as are moſt common. For inſtance, in Normandy aſhes of ſea-wrack, which are very cheap there, may be uſed. This, which is rejected for dying and lyes, as being more impregnated than alkaline with ſea ſalt, may be advantageouſly uſed in the preparation of ſeed.

11. As it is evident that ſeed picked with care yields very few infected grains, it muſt, of courſe, where a Farmer has ſpotted grain, be of great advantage to him to change his ſeed in order to procure what is uninfected.

12. M. Tillet's proceſs may be comprehended in what follows: If the ſeed is ſpotted, it ſhould firſt be waſhed in ſeveral clear waters, till the black is quite got off; it ſhould then be put into the ſteep. If it is not ſpotted, ſoaking it in the following liquor will be enough. Make ſome lye, ſuch

as

as is uſed for linen, in a bucking-tub, putting four pound of water to every pound of aſhes. If one hundred pound of aſhes are uſed and four hundred pound of water, there will be two hundred and forty pound of lye, to which muſt be added fifteen pound of lime, which will be enough to prepare ſixty French buſhels of Wheat (betwixt ſixteen and ſeventeen buſhels Engliſh meaſure). When this ſteep is to be uſed, it muſt be heated as hot as you can bear your hand in it; the ſeed, being put into baſkets, muſt be plunged into it, and ſtirred with a ſtick; the baſkets muſt then be raiſed and kept up by ſticks on the edge of the bucking-tub for the lye to drain; the ſeed being thus prepared muſt be laid on the floor of the granary till it is dry enough to ſow. If it is prepared long before it is wanted, it muſt be, from time to time, ſtirred with a ſhovel to prevent its heating; with this precaution it may be kept a month, or even a whole year.

We prepared ſome ſeed in this manner at M. Taponat's, near Rochefoucault in 1760; and in 1761 we ſaw with pleaſure that the corn ſo prepared was uninfected, whilſt in the neighbouring fields, a fourth, a third, and even half the crops were ſpoiled by this diſtemper.

All the trials that have been made evince that acrid ſubſtances are proper remedies for this diſtemper: I alſo believe all the ſteeps to be good; but prefer M. Tillet's as being more acrid, and leaſt coſtly. I imagine lye that had been uſed for linen might do, only ſtrengthening it with ſome ſea-wrack, and putting twice as much lime. I know this lye to be very acrid, but cannot anſwer for its efficacy in preſerving corn from being burnt, becauſe for ſeveral years paſt we have ſcarcely had any of our grain ſo infected.

13. Several Farmers in different provinces have uſed a ſolution of Arſenic to prepare their ſeed. Great complaints have been made in all quarters of it. Among others, a Phyſician publiſhed an eſſay to ſhew of how much importance it was to prohibit the uſe of this poiſonous ſteep. He there enumerates all the accidents that have happened to the ſowers and to the men that made the preparation, of which himſelf was a witneſs. Since M. Tillet has given us a method ſimple and innocent in itſelf, but little coſtly and of great efficacy to clean ſpotted grain, it is to be preſumed that no body will uſe this pernicious drug, from which ſuch melancholy conſequences may enſue, if by

accident any of it ſhould be mixed with the meal, and if the light corn is given to the poultry or cattle; beſides, this poiſoned ſeed muſt kill all the partridges and pigeons that eat the uncovered grain.

As ſome people are fond of making objections, it may, perhaps, be urged, that if the black duſt was ſo infectious, this diſtemper would make from year to year ſuch progreſs, that in the end we ſhould have nothing but burnt grain. But we need not be apprehenſive in this reſpect; and a year in which much corn is infected, ſucceeds one in which ſcarcely any burnt grain was to be met with. Scarcely any was to be found in the crops of 1754, 1760, and 1761.

In reflecting on this objection, which has ſome weight, I think I have found an anſwer to it in M. Tillet's obſervations, which is, that hard winters, paſt all doubt killing the diſtempered plants, ſtop its progreſs.

It may alſo be ſaid, that if this diſtemper is only cauſed by the infectious duſt, how can it at firſt get footing in a province that was before unacquainted with it?

It is readily allowed that this diſtemper may be attributed to other cauſes beſides the black duſt: but M. Tillet's experiments inconteſtibly prove this duſt to be contagious; and his reſearches ſupply us with the means of leſſening conſiderably, if not entirely extirpating this diſtemper: thus we may have larger crops, better bread, and corn more proper for keeping. What a ſatisfaction muſt it be to a man to have made a diſcovery ſo uſeful to his fellow-creatures, whoſe chief food is the ſeveral ſorts of grain? We ſhall ſoon ſee whether habit, ſupineneſs, and ill-judged œconomy in the Farmers, will not prevent them from reaping any benefit from M. Tillet's labours, who yet propoſes to them ſimple and cheap methods of attaining an end which to them ought to be of infinite conſequence.

ARTICLE III.

Of the Diſtemper in Rye, called Ergot.

Tho' all I have hitherto ſaid principally regards the culture of Wheat, yet the ſame principles may be applied to other grain: I ſhall now mention a diſtemper which often attacks Rye, and ſometimes alſo affects Wheat. What follows will give an idea of the nature of this diſtemper.

1. The affected grains, being larger and longer than ſuch as are healthy, puſh out of the chaff, appearing ſometimes ſtraight, often more or leſs crooked.

2. On the outſide they are brown or black; their ſurface is rugged, and three furrows are often ſeen in them, which extend from one end of the grain to the other: finally, the outward end of the grain is always larger than that which adheres to the chaff; and this large end is ſometimes cleft into two or three parts. It is not uncommon to ſee on the ſurface cavities which appear to be made by inſects.

3. On breaking an infected grain a whitiſh flour is perceived within it, covered by a reddiſh brown flour. Tho' this infected flour has ſome conſiſtence, it may, nevertheleſs, be crumbled betwixt the fingers.

4. On being put into water theſe grains firſt ſwim, but, afterwards, ſink to the bottom; on chewing they leave a pungent taſte on the tongue.

5. The chaff appears healthy, tho' what is on the outſide is ſomewhat browner than in its natural ſtate.

6. This diſtemper never affects all the grains of an ear.

7. The affected grains have leſs adherence to the chaff than the others.

8. M. Aimen attributes this diſtemper to the embryo's not being impregnated, no germ being found in ſuch as are infected. This ſame Naturaliſt, in a paper which he has ſent me, has collected many reflections and microſcopical obſervations; but I ſhall paſs them over in ſilence as being more curious than uſeful.

9. I ſhall not take up the reader's time in refuting the opinions of ſuch as have aſſerted fogs, dews, rain, and the moiſture of the ſoil to be the cauſes of this diſtemper. But I cannot omit mentioning, that M. Tillet, as well as Aimen, thinks that other plants as well as Rye are ſubject to the Ergot: M. Tillet has ſeen, and M. Delu has ſhewed me grains of Wheat infected with it. So the Ergot muſt not be confounded with the Charbon, or burnt grain; they are two ſeveral diſtempers: and what ſeems beſt to confirm this difference is, that the experiments of M. Tillet prove, that the duſt of the Ergot is not contagious like that of burnt grain.

M. Tillet is much inclined to think, that the Ergot proceeds from the puncture of an inſect, which makes a kind of gall-nut of the

Rye-kernel; and he ſuſpects a ſmall caterpillar of being the cauſe of this diſtemper. But neither he nor I can poſitively aſſert this.

If what Dodard, Languis, Fagon, Delahire, Noel, and M. Salerne, ſay of this diſtemper, is referred to, the diſeaſes cauſed by eating grain much infected with the Ergot will be fully laid open.

It is very eaſy to ſeparate the greateſt part of the infected grain with the help of a ſieve, becauſe they are generally much larger than ſuch as are ſound: the peaſants of Sologne do this when corn is cheap; but in years of ſcarcity they will not loſe even the infected grain: then it is they are infected with a dry gangrene, which cauſes the extremity of their bodies to drop off, almoſt without pain or loſs of blood; theſe miſerable wretches have been ſeen in the Hôtel-Dieu at Orleans, with nothing but the trunk of their bodies remaining, and they have nevertheleſs lived in this ſtate ſeveral days.

As the Ergot does not every year produce theſe terrible conſequences, Languis imagined there might be two kinds of Ergot; one that was not pernicious, and the other that which cauſes the gangrene we ſpeak of. It is, however probable, there is but one kind of

Ergot; and that this grain does not hurt, 1. When the Peaſants are careful in ſifting their corn; 2. When there is naturally but little Ergot amongſt the good corn. It is alſo ſaid, that infected corn loſes its noxious qualities by being kept; and it is, perhaps, on this account that the Peaſants are attacked with this gangrene in years of ſcarcity, becauſe they then eat their corn immediately after harveſt.

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CHAP. II.

Obſervations on other Diſtempers of Corn.

AFTER having treated at large what regards the chief diſtemper of grain, that is, what makes it black, we ſhall next notice the other diſtempers; viz. ſuch as make it mildewed, barren or empty-eared, parched and ſhrivelled, glazed, abortive and rickety; and alſo mention laid-corn.

ARTICLE

ARTICLE I.

Of mildewed or ruſty Corn.

The Mildew is a diſtemper which attacks the leaves and ſtems of Wheat. It ſhews itſelf by a ſubſtance of the colour of ruſty iron; it covers the leaves and ſtems of Wheat, when in its greateſt vigour. This ſubſtance does not adhere ſtrongly to the leaves; for I have ſeen white ſpaniels with their coat covered with a red duſt, after hunting in a field of Wheat infected with this diſtemper. It is alſo well known, that a heavy ſhower of rain will waſh this ruſt or mildew off the Wheat, and it will be but little injured. The colour of the leaves have, doubtleſs, induced ſome Farmers to diſtinguiſh this diſtemper by the name of Ruſt. It is alſo probable, but I mention it only as a conjecture, that this is what the ancients knew under the name of *Rubigo.*

The cauſe of this diſtemper is commonly attributed to dry fogs coming when the Wheat is in the height of its growth: and indeed I have ſeveral times remarked, that when a hot ſun-ſhine has ſucceeded theſe dry fogs, in a few days the Wheats were mildewed.

In very hot dry ſummers this diſtemper is much ſeen; but when the ſpring is wet, the fineſt Wheats are in danger of being ſpoilt by the mildew, which commonly ſhews itſelf when, during ſeveral dry days, no dew falls, and when in the morning after a dry fog the ſun ſhines hot: the duſt then grows ſo thick on the leaves as to be ſcattered on other plants at the diſtance of two feet. M. de Chateauvieux found that cutting off the ruſty leaves was of ſervice: the ſame plants put forth other leaves, and ſucceeded much better than what were not cut. When corn is mildewed, it may be mowed, but this muſt be when it is very young.

This is a dreadful diſtemper. The fineſt Wheats are ſuddenly reduced almoſt to nothing when the plants are very much affected.

If this diſtemper attacks Wheat when it is very young, and before it has puſhed forth its ſtem, the damage is not great, provided, however, that a kindly ſeaſon follows. In this caſe the plants are weakened as if the corn had been mowed or fed; they make freſh ſhoots, and bear ears; yet the ſtraw is ſhorter and the ears are leſs. But when the mildew, at the ſame time, attacks the leaves and the ſtem, the growth of the plant is ſtopped, inſomuch that there enſues an immenſe loſs in the crop, which is much diminiſhed.

This dreadful diſtemper is well deſerving of all the attention of Naturaliſts that are lovers of Agriculture; and I cannot ſufficiently urge them to ſearch into its cauſes and remedies.

Several witers have injudiciouſly confounded the Mildew, or Ruſt, with other diſtempers of grain. M. Tillet attributes it to the acrimony of fogs, which wound the texture of the leaves and ſtems, and occaſion an extravaſation of a fat and oleagenous juice, which, drying by degrees, is converted into a kind of orange tawney-coloured duſt. On examining plants of Wheat, the leaves and ſtems of which are mildewed with a powerful magnifying-glaſs, one may diſtinctly ſee little cracks in the ſpots where the red duſt is, and that the epidermis, or outward thin ſkin of the plant is here and there wounded: this juice dried to a reddiſh duſt ſeems to have come out of theſe little openings, over which little fragments of the epidermis may be ſeen, which perfectly cover theſe ſmall apertures.

Be it as it may, the mildew of corn is the conſequence of a diſtemper, the cauſe of which is not yet perfectly known. It is an errroneous erroneous opinion to imagine that the ruſt and farinaceous duſt that is ſeen on ſeveral plants, is a maſs of eggs that inſects have depoſited there, deſtined to produce a numerous family very deſtructive to vegetables. If we eſteem the extravaſation of the nutritive juices, the cauſe of theſe diſtempers, it will appear that the mildew, the honey-dew, the farinaceous dew, and that unctuous matter which is ſeen on gramineous plants, partake of the quality of the juice concentrated in the plants, on which it ſhews itſelf by evaporation, and is converted ſometimes into an impalpable powder, and, at other times, into that thick ſubſtance which is ſeen of a red colour on Garden-beans, reddiſh only on gramineous plants, greeniſh on the Plumb-tree, yellowiſh on the Aſh, white on the Larch-tree, &c.

Theſe obſervations and reflections leave, doubtleſs, many things undecided; it is however certain, that they will put a careful obſerver into a proper train, and ſhould excite the Naturaliſts to exert themſelves in a point of ſuch publick utility. We ſhall not diſſemble our having tried to produce the ſame effects as the dry fogs which cauſe the mildew, by applying to the leaves of ſeveral plants acid and corroſive liquids, and often glutinous juices capable of ſtopping the tranſpiration, without injuring the texture of plants. But, notwithſtanding all our endeavours, we could perceive nothing that reſembled mildew: but who can tell how far the ſagacity of Naturaliſts may go? Some ſmall circumſtance might have eſcaped our obſervation, which perhaps hindered us from perceiving an object to which we had nearly approached. The good of the public induces us to wiſh that Naturaliſts would cloſely apply themſelves to the diſcovery of a matter which may in their hands turn out of ſuch univerſal utility.

M. Ginanni, in a paper publiſhed in the Journal économique, October 1761, expreſsly treats of this diſtemper: he ſays, that by the help of a microſcope he has diſcovered worms which had fixed themſelves under the epidermis of the leaves.

If the cauſes of Mildew were certainly known, preſervatives againſt that diſtemper would, probably, be with more eaſe diſcovered; but it is, in the mean time, proper to collect all the obſervations which the lovers of Agriculture may make on this diſtemper: theſe muſt, of courſe, be very uſeful.

M. de Châteauvieux obſerved, in the autumns of the years 1753 and 1754, that when the corn was mildewed, the ſecond crop of graſs on the meadows was effected in the ſame manner; the leaves from a beautiful green aſſumed an ugly ruſty colour like mildewed corn; the graſs was equally duſty, and had every day a ſenſible diminution. As whole fields of corn are ſeldom infected in the ſame manner, the mildew extended over only a part of the meadows.

The ſame cauſe, doubtleſs, produces this diſtemper both on corn and graſs; but the effect is is not exactly the ſame. Annual plants, ſuch as Wheat, may be entirely killed by it; but in perennials, ſuch as the Graſs of meadows, it does not kill the plants, the leaves only being injured. But may not their preſervation be attributed to the abſtraction of the leaves by mowing the meadow? I acknowledge, I have made no obſervation on that head.

As the ſtraw of ſmutty or mildewed corn, as well as hay, may create diſeaſes in cattle, it were to be wiſhed that, for the public good, in places where they have much mildewed or ſmutty fodder, the worſt part were laid aſide; and that an experiment were made by feeding ſome particular cattle, to know whether it would have any effect on their health. If, after feeding on it two or three months, they continued well, this fodder might with ſafety, in future, be indiſcriminately uſed: but if, on the contrary, theſe cattle ſhould be unhappily affected by it, a ready and efficacious remedy would be at hand. By feeding them with good and well-conditioned hay, the diſeaſe would ſoon be got the better of; it would thus be ſpeedily diſcovered, that the ſource of this pretended contagious diſtemper was only to be found in the quality of the fodder.

ARTICLE II.

Of empty-eared Corn, (Blés coulés).

We mean, by empty-eared corn, ſuch as has ears entirely empty at the point, inſtead of being filled with good grain the whole length; or ears, containing ſmall kernels void of flour, and which run thro' the ſieves with the duſt and ſeeds.

This accident, which in ſome years is common, and conſiderably leſſens the crops, may be produced by ſeveral cauſes.

1. Much cold rain, when the corn is in bloom, may hinder the impregnation; this is often the caſe with grapes, which remain dry and without juice.

2. Some have attributed it to the effects of lightning; and this is not improbable, as we well know the great effects of Electricity, with which the air ſo much abounds when the weather is inclinable to be tempeſtuous.

3. When the corn is putting forth its ear, it ſometimes happens to freeze, and this certainly injures the point of the ear; which part can then yield no good grain.

4. I muſt add, that if by any cauſe whatever, the courſe of the vegetation is diſordered, or ſuſpended whilſt the grain is forming, the grains at the point of the ear, which are laſt unfolded, ſuffer moſt. For this reaſon, grain well tilled is leſs ſubject to this diſtemper than others: becauſe the conſtant plowings, keeping the vegetation always in full vigour, are favourable to the perfect formation of the grain the whole length of the ear.

As the little grains at the points of the ears are not always incapable of ſprouting, this diſtemper cannot always be owing to a want of impregnation.

ARTICLE III.

Of parched and ſhrivelled Corn, (Blés echaudés et retraits.)

When corn appears wrinkled on the outſide, inſtead of being full of flour and ſmooth on the ſurface, it is ſaid to be parched and ſhrivelled. This grain, it is true, yields good flour; but in a ſmall quantity proportioned to its bran, of which it has at leaſt as much as the beſt-conditioned wheat. Yet if the grain is not too much affected, tho' parched and ſhrivelled, it ſprouts well, and is not totally unfit for ſowing.

It is certain that this defect is cauſed by ſome accident, which ſtopped the flux of the nouriſhment to the kernel, when it was almoſt formed. Thus the grain, having attained its full growth, but being puſhed on to maturity before the farinaceous part was perfected, muſt, of courſe, be parched and ſhrivelled. It is evident that many circumſtances may cauſe this diſaſter.

1. When corn is laid whilſt the kernel is ſtill only a milky ſubſtance, the ſtem being broke, or even only bent, prevents the food from flowing to the ear; the grains receiving

then no more aliment, ripen without being firſt filled with flour, and remain rugged, wrinkled, and ſhrivelled.

2. If, whilſt the corn is green, great heats come on, the ſtraw is dried and the grains ripen without being ſufficiently filled with flour; ſometimes the flower is totally wanting; in either caſe they are parched.

3. The backward Wheat, and ſuch as has had too much moiſture, is moſt ſubject to this accident.

4. M. Tull ſays, that in cold countries there are certain inſects which, by piercing the ſtalks, intercept the courſe of the ſap, and occaſion this diſtemper; but, as I have had no opportunity of ſeeing theſe inſects, I ſhall not dwell on this matter.

It is then certain, without attempting to exclude other cauſes, that Wheat laid before the kernels are ripe, yields ſuch as are ſhrivelled; and that corn puſhed on to too haſty a maturity by ſudden and great heat, is ſubject to the ſame defect as well as to being parched.

ARTICLE IV.

Of glazed Corn, (Blés glacés.)

In deſcribing the diſtempers to which Wheat is ſubject, we think it incumbent on us to mention a defect not very conſiderable, it is true, but which leſſens the value of corn affected by it; particularly in years of plenty, when buyers are nice.

The knowing dealers require that Wheat ſhould be heavy, and have a ſmooth ſurface; that is, that it ſhould not be parched; moreover, its colour muſt be a bright clear yellow. If it is of a dead white they think it has been damp, and reject it accordingly: if the corn is of a deep yellow, and in part tranſparent, it is ſaid to be glazed, and they make a difficulty of taking it: this happens to corn that was ripened by great heats, but at a time when flour was nearly formed.

This glazed corn, however, ſprouts well, yields plenty of flour, and makes good bread; but I am apt to think this flour does not ſoak up ſo great a quantity of water when it is made into dough, as the beſt meal does: this is the only defect I know in glazed corn; neither am I certain this is a fact. I only mention it in this place, that the Farmer may not be ignorant of an accident, which the dealers are very apt to exaggerate, that they may get ſuch corn the cheaper.

ARTICLE V.

Of abortive or rickety Corn, (Blés avortés).

This diſtemper came firſt to my knowledge by means of M. Tillet's papers: it is very rare in our grounds; but I have ſince had an opportunity of ſeeing it at M. Trudaine's at Montigny; M. Tillet repreſents it as very fatal. It ſhews itſelf long before Harveſt, when the ſtalk is but eighteen inches high: the mark that characterizes it, is a deformity of the ſtalk, the leaves, the ear, and even the grain.

The ſtem of rickety corn is generally ſhorter than that of other plants of the ſame age; it is crooked, knotted, in a word, ricketty, in the true ſenſe of the word; the leaves are commonly of a bluiſh green colour, curled up in various ways; ſometimes turned like wafer-cakes, and often rolled in a ſpiral form. The ears have very little of their natural form; they are lean, withered, and ſhew very imperfect rudiments, either of the chaff or grain.

All theſe ſymptoms together are only to be found in plants that are in the height of the diſtemper. The ſtalks are often pretty ſtraight, the leaves but little curled, and the chaff tolerably well formed; but, inſtead of encloſing a ſmall embryo, white and velvetty at the ſummit, it contains only a green kernel, terminating in a point, not unlike a young pea about to be formed in its pod.

Theſe abortive kernels have often two or three points very viſible; they are then faſhioned as if two or three ſmall kernels were joined together at the baſe. When theſe kernels are ripe, or rather when they are dried up, they grow black, and ſo much like the ſeeds of Cockle, that the Huſbandmen who know nothing of this diſtemper, often confound the abortive Wheat with the ſeeds of that weed.

The following are the principal obſervations M. Tillet made on this diſtemper.

1. The abortive ears are generally produced by rickety ſtalks, of a white colour, with curled leaves.

2. The rickety ſymptoms appear in the ſtalks by the time they are three or four inches high.

3. Whilſt the rickety ſtalks are yet low, they are tender and of a yellowiſh colour; the leaves are of the ſame colour, a little curled, and as it were, withered: yet ricketty plants often appear ſtronger than the others.

4. As the rickety ſtalks grow they become green, and afterwards aſſume the bluiſh colour which characterizes them: their leaves remain curled, become bluiſh, and have not the ſubſtance of ſuch as are healthy.

5. The rickets is not a diſtemper peculiar to poor ſoils. M. Tillet has ſeen it in rich land in the midſt of the fineſt tufts of Wheat; and he has ſometimes fruitleſsly ſearched for it in poor lands where the corn was weakly.

6. The roots ſeemed to partake a little of the ſame diſtemper; they were not entirely covered with their ſpongy coat, and in ſome places the internal woody ſubſtance was apparent.

7. Rickety plants ſeldom produce ears either entirely good or abſolutely abortive: a good ear is ſometimes produced by a ſtraight ſtalk with the leaves a little curled.

8. Abortive kernels are like young peas, and have viſibly two or three points.

9. Abortive grain which commonly grows on rickety ſtalks, with curled leaves, is ſometimes

times intermixed on the ſame plant with burnt grain, which grows on ſtraight ſtalks, with the leaves not curled.

10. Rickety ſtalks ſometimes bear ears which contain ſome healthy and ſome abortive grains.

11 Abortive grains ſcarcely adhere at all to the chaff, and are eaſily ſhed when their covering is opened.

12. An abortive grain has ſeldom the three ſtamina; there are ſometimes but two, and oftener only one, or none at all.

13. The grain is ſometimes rendered quite abortive before the ear is unſheathed.

14. When the ears of abortive plants have been ſome time expoſed to the air, the chaff begins to grow white, and the kernels become black and dry.

15. Some ſtalks of Wheat, tho' of the rickety kind, are ſtraight and tall, and have the leaves of the third and fourth joint only curled: in this caſe the ear contains, 1. Abortive kernels of one, two, or three parts; 2. Abortive grains encloſed in the ſame chaff, with white grains furniſhed with two or three yellow ſtamina; 3. White grains furniſhed with three very green ſtamina; theſe ſeem as if they would produce healthy grain.

Thus is this diſtemper well characterized by obſervations. I relate them as they are to be found, in the diſſertation which gained the prize of the Academy of Bourdeaux, that a diſtemper may be made public, which, as the author ſays, is in a manner unknown to almoſt every Huſbandman. As I have not had ſo good an opportunity of obſerving this diſtemper as M. Tillet has, I ſhall omit ſaying any thing of its cauſes, or of the precautions that may be taken to guard againſt it. I ſhall content myſelf with ſaying, that M. Tillet ſuſpects this diſtemper to be occaſioned by inſects: he ſays, that on the ſickly plants, where he found inſects, he perceived ſmall drops of a very limpid liquor, which he judged to be extravaſated ſap.

ARTICLE VI.

Of barren Corn, (Blés ſtériles.)

The laſt diſtemper I have to mention is that to which M. Aimen gives the name of Sterility. There are found, he ſays, in the province he lives in ears of Wheat and Rye that are long, lean, and white; in ſome the ſtamina are dry, tranſparent, and horned; the female organs are ſmall, whiter, and leſs velvetty than in healthy ears: in others the filaments are ſwelled, the apices void of duſt or farina, and the ſtigmata badly unfolded. The ſtigmata of all the bloſſoms of an ear are ſometimes dried and parched; at other times the apices are ſwelled.

M. Aimen thinks with Theophraſtus, that theſe accidents happen to plants that grow with moſt vigour. Then, ſays he, the ſap which is powerfully conveyed into the leaves of the plant, or other parts, prevents the organs of fructification from unfolding themſelves.

He alſo imagines that froſt may cauſe this accident, by particularly affecting the female organs: and he thinks that a hot gleam of ſun-ſhine coming after a hard ſhower, may have the ſame effect. If this is the caſe, the diſtemper in queſtion may be ranked with the parched and ſhrivelled corn, or perhaps with the empty-eared corn: finally the ſame Naturaliſt obſerves, that inſects are ſometimes, yet very rarely, the cauſe of this diſtemper.

ARTICLE

ARTICLE VII.

Of Laid Corn, (Blés verſés.)

The fineſt plants of corn, which having been well tilled and manured, have run up to a great height, are not always thoſe that yield the greateſt quantity of grain, or the beſt conditioned. Corn grows perpendicularly in height, unleſs accidentally put out of this natural order: the moſt common accidents are wind and rain. The ſtraw is pliant and bends, and yields to the wind; but, by means of its elaſticity, regains its former perpendicular poſition as ſoon as the wind ceaſes to blow; but when rain is added to the wind, the wet makes the ears heavy; and the ſtraw, being weak near the earth, breaks. It cannot then immediately riſe, and, if there is graſs on the ground, it ſoon over-tops the corn, and prevents its ever riſing; for it ſometimes happens that the foot of the ſtraw not being broke, if the wind and rain ceaſe, ſuch ſtalks as were only bent, riſe again, and ſcarcely any damage enſues. But this is not the caſe when the ſtraw is broke, and the graſs over-tops the corn. If this accident happens ſoon after the bloom, the grain, which is no longer nouriſhed, remains very ſmall, and conſiſts almoſt of bran alone: the loſs then becomes conſiderable; for, beſides the crop of corn being diminiſhed, the ſtraw rots and becomes unfit for foddering cattle.

If corn is laid when it is near ripe, it only becomes ſhrivelled: however, if the harveſt proves warm and dry, it turns to pretty good account; but if it proves wet the corn is very apt to ſprout.

If the weather is very windy when the corn is ripe, it ſhales; and the ſtalks being interwoven, a great deal is loſt on the land, let the reapers be ever ſo careful.

The corn that is only bent ſometimes riſes again as I have already ſaid; but if it even does not, it continues to grow, the ears enlarge, and are filled in their whole length with grain, which ſometimes are not even ſhrivelled. What is moſt to be apprehended in laid corn is, the birds lighting on it, devouring the grain, and laying it flat on the ground. Theſe accidents excepted, one may ſee corn bent without uneaſineſs; in ſome caſes it is even of uſe. When corn is bent, the point of the ear is next the ground, and the chaff forming a kind of covering to it, the water runs off without ſtopping in the interſtices of the grain, as it does when the ears are upright, and thereby altering the quality of the grain, and rendering it leſs fit for keeping. But, if by its being bent the water does not penetrate the ears, it is certain an upright poſition is better adapted to their being dried by the wind; and it is always to be apprehended that bent or inclined corn may be totally laid by long-continued rain, when at length it ſprouts.

If it could be foreſeen that the year would be kindly, we ſhould certainly be cautious of over-dunging good land, leſt the corn ſhould be laid; for in kindly years, it is generally the fineſt corn, that which has been beſt tilled, and has had moſt dung, that is laid, and turns out leaſt profitable to the Farmer. Laſt year 1761, the low and ſeemingly indifferent corn yielded finer and better grain than what appeared tall and beautiful.

But as it is impoſſible to foreſee what weather will happen, the Farmers till and mend their lands as well as they can; and when they perceive they grow too high they mow them. By this means they backen their growth, which anſwers the Farmer's intention, who would not have his corn laid.

It is well known that an inſulated plant of Wheat, tho' deſtitute of ſupport, is never laid. The reaſon is, that the foot of the ſtalk, being continually expoſed to the action of the air and ſun, becomes hard, firm, and elaſtic; whereas the ſtalks of corn, growing collectively in a field, continue tender near the ground, and are eaſily broke.

After having treated of the preparations neceſſary for obtaining a good crop, and the means of guarding as much as poſſible againſt the accidents that may endanger its ſucceſs, it is time to ſay ſomething of getting it in.

ELEMENTS

OF

AGRICULTURE.

BOOK IV.

Of the getting in Grain.

WE are now come to the time when the Huſbandman ſhould receive the reward of his labour. His work is about to be doubled; he muſt augment the number of his workmen, which will encreaſe his expence. But he will ſupport all chearfully if he fills his barns with good corn. All poſſible diligence ſhould be uſed in this work; for if whilſt the corn was green, he apprehended hail, which is ſo deſtructive, and tempeſts, which lay the fineſt corn; he ſhould now guard againſt the blaſts of wind, which ſhale the ripe ears, and which, by entangling the ſtraw, hinders the reaper from making clean work; on the other hand, too much rain makes the grain ſprout in the ears, or, at leaſt, injures it in its quality. After ſome general obſervations on Harveſt, we ſhall give an extract of a diſſertation on the mowing of Wheat; and, afterwards, collect a few obſervations on the method of houſing and dreſſing grain.

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CHAP. I.

General Obſervations on Harveſt.

THERE are three points to be obſerved in harveſting; 1. The neceſſary preparation; 2. The proper ſeaſon; 3. The manner of cutting the corn.

ARTICLE I.

Preparations neceſſary for Harveſt.

A ſufficient number of workmen muſt firſt be provided, in proportion to the quantity of corn to be got in. Theſe workmen are reapers who cut the corn and tye it up; one or two men muſt be provided to ſet up the ſheaves in traves, and help to load the carriages; ſome men to houſe it properly, or ſtack it. The bands for the ſheaves are made by the houſhould ſervants, who in harveſt-time ſhould be remarkably aſſiduous, in giving what help they can: finally, there muſt be mowers, chiefly to cut the Barley and Oats. Reapers and mowers generally take their work, the others are hired for the harveſt.

As, in this ſeaſon, the Farmers have many mouths to feed, they ſhould lay in a ſtock of proviſions, particularly meal; for, at this time of the year, the waters are often low, and there is little wind ſtirring, ſo that they may ſometimes be in want of bread, yet have plenty of corn.

In many provinces, workmen join together and undertake all the harveſt-work; in conſequence of which they cut the corn, tye it up, load the carriages, and houſe it in the barns; they even ſometimes undertake to thraſh it; ſo that the owner has nothing to find but carriages. There is alſo an eaſy method of paying theſe undertakers, by giving them a ſeventh, an eighth, or a ninth of the crop. It is not poſſible for me to give an account of the different agreements that can be made by Farmers with men that undertake their harveſt-work; but one point of great importance is, that the corn be got in with all poſſible expedition.

ARTICLE II.

Time proper for Harveſt-Work.

It is impoſſible to fix with preciſion the time when Harveſt ſhould be begun; it is earlier or later in the ſeveral provinces, and is governed by the ſeaſon, whether it is hot or cold, dry or wet. But, in general, the ſtraw and ears being turned to a yellow or white colour, denote that the grain is ripe. The ſtalk ſhould alſo be examined near the ground, where it is longer drying than elſewhere: for as the ſtraw, when it is dry, no longer gives nouriſhment to the grain, the corn ſhould then be cut.

If corn was cut too green, it will become ſhrivelled in the ſtack. If it is cut too ripe a great deal of it ſhales, and is loſt in the fields. To keep the mean way, the corn ſhould be cut when the grains begin to harden, without ſtaying, however, till they are ſo brittle as they ſhould be if perfectly dry.

When there is a great deal of work to do, that which is forwardeſt ſhould be firſt cut;

for all the lands of a large farm are not of the ſame nature; and the corn is ſooner ripe on light ſoils than on ſuch as are ſtiff and heavy; the work ſhould be concluded with ſuch lands as are moſt backward; and, as it takes up much time to get in a large quantity of grain, ſome ſhould be cut before it is quite ripe. It certainly ripens in the heap, and it is of great importance that it ſhould not ſhale. Particular care muſt be taken of the Summer-wheat, which is more apt to ſhale than others. On the other hand, that intended for ſeed-corn ſhould not be cut till it is perfectly ripe, tho' a part of it ſhould ſhale and be loſt.

Some that have but little to do leave off reaping at noon; becauſe in the heat of the day the corn ſhales more than in the morning and evening. But a Farmer who ſhould be ſo nice in large concerns, would too much retard his work; and his corn growing too ripe, he would be in danger of loſing a great part of it. The beſt way is always to get as forward as poſſible.

If corn is cut green, and is intended to be thraſhed out of hand, the ſheaves ſhould be laid in heaps, the ears againſt ears, and at night,

night; the ſheaves ſhould be taken from the heap and ſet on end. By repeating this four or five days the corn will be fit to thraſh. But in countries where they keep their ſtacks or barns, and only thraſh it in winter, it may be ſtacked out of hand; the heat it contracts being no more than what is required to ripen it.

The general cuſtom is to reap all day; in the evening they ſet the corn up in traves, and early the next morning, before the dew is off the ground, they houſe it.

They leave the gavels all day on the ground, not only the better to dry them, but to wither the graſs that is at the foot of the corn; for, if it was to be houſed green, it would heat ſo much as to loſe its vegetative quality. Thus years that are very weedy, they leave the corn longer in gavels than they do at other times.

They tye up the ſheaves, and ſet them up in traves in the cool of the evening, to prevent the corn from ſhaling. And for the ſame reaſon cart it early in the morning.

Theſe circumſtances muſt naturally, on many occaſions vary, and a method quite different muſt be purſued if the weather is wet. Some years are very unfavourable in this reſpect; and I have ſeen Harveſts ſo wet that ſcarcely a ſingle a ſingle load could be got in dry. The ſtacks heated ſo much that the grain grew red and would not grow.

ARTICLE III.

Different Ways of cutting Corn.

In the Angoumois, as well as in all the places where the land is plowed in ridges, they reap their corn, which makes the Harveſt tedious. We have already ſaid in treating of plowing, that much ground is loſt by plowing in ridges: the ſowing is troubleſome, as they are obliged to cover all the ſeed with the plow: and it appears alſo, that this method increaſes the expence of Harveſt. It is beſt, therefore, not to plow in ridges but where it is abſolutely neceſſary.

In Beauſſe, Brie, and ſeveral other provinces, where they plow flat, or in large ſtitches, or broad lands, they reap Rye and Wheat with a ſickle. But they mow Barley and Oats. The ſheaves are tied with bands of Rye-ſtraw, two lengths of which are joined together by a knot at the end that bears the ears.

In other places they bind the ſheaves with withs; and as the Peaſants, in certain diſtricts,

ſtricts, claim a right of cutting theſe withs in all woods, they do great damage to the young ſhoots, chuſing always ſuch twigs as are ſtraighteſt and leaſt knotty.

In Flanders, Hainault, Switzerland, &c. they mow their Rye and Wheat. Our Farmers in the Gatinois never uſe this method but when their Wheats are low, thin, and very weedy; but ſome Peaſants, who hold but little land on the borders of the foreſt of Orleans, mow all their Rye and Wheat without diſtinction.

Reapers are often ſubject to diſtempers; becauſe, having their bodies always bent towards the ground, they breathe a hotter air, by the ſun-beams reflecting on the land.

Theſe workmen think that drinking a great deal refreſhes them; but their liquor, heated by the ſun, does not quench their thirſt; and I even ſuſpect this profuſe drinking contributes to make them ill. Beſides, the method of cutting corn with a ſickle is tedious. It would then be a uſeful diſcovery to find a method of cutting corn with ſome machine that would eaſe the men of a part of this heavy labour. Till ſome Mechanic has effected this, I would propoſe the uſe of the ſcythe inſtead of the ſickle: the ſcythe rids more work: the proportional expence of reaping an acre, to what it would be for mowing it, is five to two. It is true that the mower ſtrains every part of his body, and muſt be more expert than the reaper; but, as the mower is always erect, he has the benefit of every breath of air that is ſtirring to refreſh him; and, in this reſpect, has the advantage of the reaper.

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CHAP. II.

Extract from a Paper of M. de Lille, on the Mowing of Wheat.

I Am well perſuaded the public will be pleaſed with the following extract from a paper ſent me by a worthy gentleman, who has in his own lands tried the method he recommends. He firſt deſcribes the ſcythe, and the mechaniſm of mowing Wheat, and next diſplays the advantages of it, and anſwers the objections that have been made to him.

SECT. I. *Deſcription of the Scythe: Mechaniſm of Mowing.*

The Flemiſh workmen M. de Lille employed in 1753, brought with them ſcythes, no ways differing from thoſe commonly uſed, either in ſize, mounting, or the ſize of the cradle.

It was not till 1755 that any alteration was made in that inſtrument, in conſequence of ſome very ſenſible remarks made by a workman M. de Lille employed after the Flemiſhmen above-mentioned.

This mower obſerved, that the common ſcythes were only fit for lands plowed in ſtitches, and could never be uſed in ſuch as lay in ridges of ten or twelve furrows, and raiſed high in the middle: he alſo remarked, that it broke the ſtraw, ſcattered many ears, and did not touch the ſhort ſtalks that grow at the bottom of the furrows, which occaſioned a loſs; and that they did not gather the corn as well as was neceſſary. To remedy this, he made uſe of a ſcythe, at leaſt, ſix inches ſhorter than the common ſcythe; and, laying aſide the cradle, ſubſtituted what he called (in French) *le Playon.* This *Playon,* A (Pl. 2. fig. 9.) conſiſts of two twigs of hazle, or other green wood, which are placed in a ſemicircle on the handle of the ſcythe at the place where the cradle is fixed. For this purpoſe there muſt be four holes in the handle: one end of one of theſe twigs is put into the firſt hole, and the other end into the third; and one end of the other twig is put into the ſecond hole, the other into the fourth. This is all the mounting of the ſcythe; we ſhall now explain the manner of working with it.

In mowing Oats, the corn is always on the workman's right hand, and the motion of the ſcythe carries the ſwarthe to the left. The mower of Wheat, on the contrary, takes the piece the other way; ſo that the corn that is to be cut is always on his left hand; whence it follows that the corn as it is mowed, being kept together by the *Playon*, is borne to that which is yet to cut, and leans gently againſt it.

A workman (or even a lad of twelve or fifteen years old, or a woman,) follows the mower at about four or five feet diſtance, provided with a ſickle, or a ſtick one foot and a half, or two feet long: he paſſes this betwixt the cut corn and that which is ſtanding, takes it in his arms, ſtrikes it againſt the ground to form a gavel, and lays it down on his right hand. This ſhould be done with agility; becauſe this workman, who is called the Gatherer, is followed by another mower: and it ſhould be done with dexterity; becauſe, on this depends the quantity of the gleanings. There ſhould be as many gatherers as mowers.

It is neceſſary to remark the poſture of the mower. In mowing Graſs and Oats the mower traces two parallel lines with his feet, which he moves forward alternately to every ſtroke of the ſcythe. In mowing corn the mower's path ſhould be only traced in a ſingle line; becauſe he ſhould ſtep one foot before the other, in ſuch a manner as that the left foot, which is behind, ſhould, as it were, drive the right foot forward; a poſture ſomething like that we put ourſelves in when, foil in hand, we are about to fence.

The reaſon for this difference of poſture was diſcovered to M. de Lille by an accident which, in 1754, had like to have overſet all he had done. He employed for mowing his Wheat workmen that came every year to mow his Oats; they were in number ſeven. The third day of working, five of them were taken ill; he immediately replaced them by three others; but this occaſioned his having ten ſick men inſtead of ſeven at the end of the week. He viſited theſe workmen, and enquired into their diſorder: ſome of them were feveriſh; but all of them complained of exceſſive pains in their left ſides. M. de Lille, at firſt, thought they were all ſeized with the pleuriſy; yet there was room for doubt, as he found in their caſe many ſtrong reaſons to conclude their diſorder to be only a cramp; in conſequence of which opinion the only remedy he preſcribed was reſt.

The next day, as he returned from viſiting his ſick men, he perceived two mowers at work on his corn; he went towards them, and ſaw that their poſture was the ſame as in mowing Oats. He exclaimed at this aukwardneſs, which he immediately ſaw was the cauſe of his firſt mowers illneſs.

As they then uſed the ſcythe with a cradle, which is heavier than that which has only a *playon*, he took one of the ſcythes; and putting himſelf in a poſture as if he was going to mow Oats, he demonſtrated to them, that having in mowing Wheat a much greater weight to carry on the ſcythe, it required a very painful inflection of the body to bear the corn to the left. He then put himſelf in the poſture he had obſerved in the Flemiſhmen, who had worked for him the preceding year, and ſhewed his workmen that this was the moſt proper attitude for a man to exert his whole ſtrength, the ſway of his body from the right to the left helping him to bear the weight of the corn without any ſtreſs on his ſides. The man took his ſcythe again, and, having tried this new method, was convinced that it was right, and taught it to his companions: ſince that time it has been quite familiar to them. It was thought proper to relate this circumſtance, as it is a demonſtration that the ſtrongeſt and moſt robuſt workman cannot long ſtand to his work of mowing Wheat, if he attempts doing it in the manner Oats are mowed.

This is the mechaniſm of mowing Wheat, when it is upright; that is to ſay, in very favourable years. It muſt be added, that the mower ſhould be careful to take the advantage of the wind, ſo as to have it at his left; becauſe then the corn naturally inclines towards the ſcythe, and may be cut cloſer to the ground: the action of the wind, tho' ever ſo trifling, bears the corn towards the ſcythe;

and it is more properly diſpoſed, ſo as to be ready to be taken up by the gatherers.

When the wind is in the back of the mower, it does not prevent his cutting cloſe; but the corn is not laid ſo compact; for ſeveral ears are ſcattered; and the greateſt inconvenience is, that the cut corn which leans againſt that which is ſtanding, loſes its biaſs, and is often thrown down by the wind; this makes the gatherers work more tedious, and encreaſes the gleanings.

A wind in front is very bad; the ſcythe does not take a good hold, and the ears are ſcattered.

The wind on the right is worſt of all; the ſtubble is left long, and there are ſuch a number of ears left on the land, that one would ſcarcely think any crop had been taken from it.

When the corn is bent, the mower ſhould take his work in ſuch a manner as to have it incline from his left to his right; which, when the weather is calm, has the ſame effect as if the wind was at his left.

When the corn is laid, it is not eaſy to mow inwards; becauſe the gatherer would be continually embarraſſed by the mixture of his gavel with the unmowed corn. A good mower, at firſt ſight, knows the way he ſhould take his work; when the wind can give him any advantage, he takes it. The moſt common method is, to take the corn according to its inclination, and throw it in ſwaths: the work is neater: and after the mowing, ſo little ſtubble is ſeen that it looks like a meadow.

No method can be propoſed for mowing corn that is lodged, (that is, when it is laid by the wind in patches, ſome one way, and ſome another) it ſhould be taken as it preſents itſelf; but always according to its inclination, as if the mower had the wind at his back; by which means it may be mowed as cloſe as when it is only laid. The crop of 1757 was lodged, yet was mowed without great difficulty: it was only ſomewhat longer about than in common years.

The ſame M. de Lille, from whom I have this whole account, adds, that he ſhall mention rainy ſeaſons only when he enumerates the objections; becauſe they do not affect the mowing, it being only neceſſary to endeavour to prevent the corn ſprouting in the gavel. He next diſplays the advantages of his method, which are contained in the next ſection.

SECT.

SECT. II. *Advantages of this Method.*

The firſt advantage is, that it makes the work more eaſy to the workmen in a ſeaſon that is very fatiguing, on account of the exceſſive heat. When corn is eaſieſt reaped, a good reaper with a ſickle can, with difficulty, cut half an arpent a day; whereas a mower, according to his being more or leſs expert, will diſpatch an arpent, or an arpent and a half: but few workmen can mow an arpent and a half without tiring. If we take the corn as it comes, upright or laid, we may reckon five quarters a common day's work for a good workman; and this may very well be done in a workman-like manner. This workman then does three-fifths more work than we can expect from one who uſes a ſickle. It is true he does not form the gavel; becauſe the gatherer, who follows him, ſaves him that trouble; but then he is very often obliged to whet his ſcythe, and the more ſo when the corn is thin. Beſides, let them be ever ſo careful in ſtoning the fields, there is not a day paſſes but what he meets with a ſtone, which obliges him to grind his ſcythe; and he is alſo under a neceſſity of going from one end of the field to the other, that he may make all his cuts in the ſame direction. All this takes up as much time, at leaſt, as the reaper loſes in laying the corn down to form gavels; and, by this compariſon of the work, it cannot, I think, be denied that mowing is three-fifths leſs laborious; to which we may add, the uneaſy poſture of the reaper compared to that of the mower.

This method ſecures the workman from another inconvenience reſulting from the hurts his hands receive from Thiſtles, Thorns, &c. which he is ſubject to meet with.

The firſt advantage reſulting from this method may be divided into ſeveral branches;

1. It is more expeditious. There is not a year paſſes in which the Farmer does not find ſome of his land too ſoon in a ſtate of maturity; which growing every day worſe is a great loſs to him, by the corn ſhaling either in the reaping, or in loading and unloading. A piece may be mowed in two days, which could not be reaped in five, by which means this accident may be prevented.

2. This way of working requires fewer hands: I ſhall explain myſelf; for I ſhould be contradicted by a fact if it was objected to me, that it requires a mower and a ga-

therer in the ſame work that a reaper does alone. But we muſt conſider that to reap ninety arpents of Wheat, will employ ten men, at leaſt, twenty days with the ſickle; when ſeven mowers with gatherers (fourteen men) will with eaſe do the ſame work in ten days. The difference is ſixty days work; and if, as was M. de Lille's practice, the ſame time was allowed for mowing as for reaping, it would then only require four mowers and four gatherers (eight men) the four laſt of which have leſs wages than three reapers; becauſe in this work young lads are employed who are not yet ſtrong enough to uſe the ſickle. Here are then two workmen ſaved, beſides ſome ſavings in the article of wages by employing lads.

3. Employing lads, old women, and men almoſt paſt labour, would be of uſe to the country. The number of workmen would be encreaſed, and begging and idleneſs prevented; a matter of a great conſequence in many reſpects. The Farmers would reap the benefit: as every pariſh could ſupply the number of men neceſſary to get in the Harveſt, they would have no occaſion to employ travellers, who exact on them, and ſometimes quit them in the middle of the

Harveſt, if they do not comply with their exorbitant demands.

But to lay aſide theory, let us take notice of ſome advantages that cannot be denied. 1. It is no inconſiderable object, that the fodder is greatly increaſed, and rendered of more value by the quantity of weeds mixed in the ſheaves. This is ſelf-evident; it is well known that the mower can go as cloſe to the ground as he will; and experience convinces us, that in a well-ſtoned field there is not two inches of ſtubble left; and that the ſickle generally leaves eight or nine, and even a great deal more, when the land is much infeſted with Thiſtles, Dwarf-elder, and other large weeds that oblige the reaper to raiſe his hand to avoid them. It is therefore evident that, by mowing the ſtraw, it is, at leaſt, ſix inches longer than by reaping, by which means a ſixth part more is houſed than common.

2. The graſs of mowed fields grows again, and affords excellent paſture after Harveſt. This will appear as evident as what we have juſt mentioned, if we reflect that the reaper, leaving eight or nine inches of ſtubble, only cuts off the top of the graſs; the conſequence of which is, that the graſs left behind being

near ripe, perfects its ſeed, and then withers. On the other hand, the ſcythe cutting it within two inches of the ground in the part where there is moſt ſap, the graſs makes new ſhoots, which are an uſeful ſupply for the cattle.

3. The paſture of mowed corned fields affords another advantage, to cows in particular. It is every year obſerved, that cows fall off their milk for the firſt two or three weeks after they are turned into a Wheat-ſtubble. The reaſon of it they ſay is, that the ſtubble pricking their noſtrils, hinders them from feeding, and makes them run about the field in ſearch of a place clear of ſtubble, in that manner loſing the time they ſhould employ in feeding. The ſhort ſtubble left by the ſcythe has not this effect, but leaves the cows at liberty to fill themſelves; the graſs ſprouts again, and yields plenty of paſture, particularly if a gentle rain ſucceeds the Harveſt.

Hence it follows, that the Farmer can keep more cattle; that he ſaves his Lucern, or Saintfoin, and makes a greater quantity of dung; all this has been proved by a ſucceſs that is almoſt incredible.

I now come to the objections, and I ſhall relate them in the order they were made.

Sect. III. *Anſwers to the Objections.*

The firſt objection is, that the ſcythe muſt, of courſe, occaſion a great loſs of grain by the ſhaking it cauſes. It may appear a paradox to affirm the contrary; but this aſſertion ſhall be proved by the principles, and by the fact. To judge of this point, the action of the ſcythe muſt be compared to that of the ſickle: they have been well examined.

The reaper, in taking hold of the corn, opens his fingers wide, ſo that his gripe contains not only what can be held in his hand, but alſo what is compriſed in the ſpace betwixt his fingers and thumb opened like a fork. The reaper having thus got hold of the corn, in order to ſecure it within his ſickle, and bend it ſo as to be cut with greater certainty, muſt ſhake it the inſtant before he applies his tool to it. The cut corn is commonly tangled with that which is ſtanding, or, at leaſt, finds ſome ſtalks in his gripe not cut, which he breaks with a jerk; whence it follows that the corn is ſeveral times ſhaken before it is toſſed in the gavel.

This is not the caſe with the ſcythe. I have already explained the mechaniſm of the work, and have made it appear that the corn being cut, almoſt without reſiſtance, is carried by the cradle of the ſcythe, to the ſtanding corn, againſt which it leans till the gatherer takes it to layin gavels; this ſaves many jerks which it receives in the other way.

M. de Lille proves his aſſertion to be matter of fact, by an obſervation made in 1752: his trial was made on pieces of ten acres taken out of larger plots.

Having taken with him four perſons, he carefully viſited the part that was mowed to ſee if any grain was ſcattered; he found none in the two firſt pieces; but in that part of them which had been reaped, the grain was evidently ſcattered. In the laſt piece which had been cut when it was riper, ſome few grains were found in the mowed part, but far more in the other. He did not every year repeat his ſearch with the ſame care; becauſe he had not the opportunity of making the compariſon; yet he ſaw enough to be certain, that no grain is loſt but when it is greatly too ripe; and that it is then much leſs in quantity by the ſcythe than the ſickle.

A more important objection was afterwards made. A very able and ſenſible Farmer ſaid, that in a rainy year mowed Wheats muſt, of courſe, ſooner ſprout than the others, their heads being ſupported by ſo ſhort a ſtubble that the water had no room to drain from them; and that, farther, the rain beating the ears againſt the graſs, the grain imbibed the moiſture of it, and muſt, therefore, ſprout the firſt hot day. But there is a very good way of guarding againſt this accident.

This method conſiſts only in diſpoſing the gavels in a triangular form; ſo that the head of one gavel may lay on the foot of the other. This is neither tedious nor tireſome; to be done quickly, it only requires a little dexterity in cloſing the triangle; the foot of the third gavel may ſerve as a bolſter for the head of the firſt. The rain in the Harveſt of the year 1756 was very troubleſome; a great deal of corn ſprouted; but what was laid in this manner did not; and the little good corn that was got in, was from what remained to mow after it ſet in for conſtant rain.

With regard to the bound ſheaves, the Flemiſh reapers have a cuſtom, when they are ſurpriſed with long continued rains, to ſet as many ſheaves an end as they can cover with one ſheaf, which ſerves as a hat for them.

From this objection aroſe another, from the difficulty there is in drying the weeds in rainy ſeaſons, and the danger of houſing ſheaves full of weeds, which may ferment and occaſion the rotting of the Wheat. The weather was very unfavourable in the Harveſts of 1756 and 1757; yet all the weeds of the ſheaves that were mowed, and theſe were in no ſmall quantity, as has been already ſaid, were houſed in good condition; no bad ſmell was perceived in the barns that teſtified a fermentation; the threſhers ſaw no ſigns of it; and the chaff, which was given to the horſes, proved there was none.

We now come to the laſt; which is of moſt importance, as it is a point to which hitherto no remedy has been found. It is this: the ears are not ſo even in the mowed gavels as in ſuch as are reaped; ſome are at the head, others at the foot of the ſheaf; whence it follows, that the corn is not ſo eaſily thraſhed, and there reſults a conſiderable loſs. 2. The weeds contained in the ſheaves are thraſhed with the Wheat, and their ſmall ſeeds are mixed with the corn the thraſher delivers,

vers, who is alſo paid with this mixed grain; it thence paſſes to the ſcreen, and the expence of ſcreening is encreaſed.

The objection holds good; but the point will bear diſcuſſion. It is true there are ears in the middle and at the foot of the ſheaves; but theſe ears ſeldom contain any thing better than Off-corn, produced by feeble ſtalks: very little elſe is found; for a careful examination has been made in this matter. When theſe ears come under the flail, they ſeldom yield their grain, but it quits the ear, together with the chaff, and forms what they call cobbs. As theſe cobbs leſſen the value of the corn, the ſcreeners pick it carefully out and give it the poultry. When theſe ears eſcape the flail, the ſtraw is better; and the horſes are benefited; and we ought not to grudge it them, as it conſtantly turns out to the owner's advantage.

The weeds and graſs being thraſhed, yield a great many ſeeds, for which, it is true, the threſher is paid. But the graſs, which occaſions this expence, ſaves a great quantity of Saintfoin and Lucerne, which the cattle would have conſumed. With regard to the encreaſed expence of ſcreening, it is unjuſt to complain, as the ſcreenings may be uſed in the family and be a ſaving to the farmer.

The real encreaſe of expence is what is paid the thraſher above the cuſtomary price. This difference which is about twenty or thirty ſols a muid (about 1s. or 1s. 6d. for five quarters and five buſhels Engliſh), is but a juſt recompence, as the threſher muſt untye and tye again one hundred and fifty, and ſometimes more ſheaves, to get a quantity of grain equal to what one hundred generally yield. But the quantity of ſtraw procured by this method makes amends ſufficient for the encreaſe of expence; a quantity of much more value than a muid of corn, which, to quiet the objectors, I ſuppoſe the loſs to be: finally, another compenſation is the ſaving in Harveſt expences.

As a farther anſwer to this objection, I ſay, that ſuppoſing the expence of Harveſt to equal what it generally is, the expence of threſhing to be encreaſed, and a muid of corn to be loſt, yet the large additional quantity of ſtraw ſaves a great deal of hay, and produces plenty of dung, very uſeful to ſucceeding crops.

Having given M. de Lille's obſervation, we ſhall proceed to the method of houſing and dreſſing corn.

CHAP. III.

Of houſing and dreſſing Corn.

I Join in this chapter two matters which will not long detain us. There is little to be ſaid on the method of houſing corn; but we ſhall enlarge a little more on what relates to dreſſing it.

ARTICLE I.

Of houſing Corn when it is cut.

In the ſouthern provinces, where the heat of the ſun is great, and it ſeldom rains in Harveſt, they generally threſh the corn on the ſpot as faſt as it is cut; and if the quantity is not conſiderable, they tread it with oxen, cows, horſes, mules, and even aſſes.

In provinces where the weather is more uncertain, they lay it in barns, or ſtack it and thatch it a-top. In ſome provinces they have very extenſive barns, in which they put all their corn; in others the barns are leſs, and as faſt as the corn is threſhed, they remove more from the ſtacks. This laſt method is very good; becauſe on one hand, the corn keeps very well in the ſtack; and, on the other, the Landlord is not ruined in buildings. Before I ſhew the reſpective advantages of theſe different methods, it will be proper to ſay ſomething more of the cuſtoms I have already mentioned.

Whether the corn is kept under cover, or immediately threſhed in the open air, a floor muſt be provided either in the barn or without it. To do this, the place where the floor is to be made muſt be dug ſix inches deep. The ſtones are to be taken away, and the ſtirred earth is mixed with clay and cow-dung: it is then drenched with water, and kneaded as if mortar was to be made of it; after the ground is levelled, this mixture is laid on it, and the ſurface laid very ſmooth with a trowel. It ſhould every now and then be wetted; and, to prevent the floor-cracks in drying, it is beat down as long as any cracks appear, and till it has acquired a very firm conſiſtence. When this floor is made in the open air, it ſhould lay high, and be ſurrounded with hurdles to hinder the cattle from injuring it; it muſt every year be repaired.

In the provinces where they tread the ſheaves with cattle, they lay the ſtraw in ſuch a manner as to have the ears as high as poſſible: a man ſtanding in the middle holds the cattle by a long rein to make them run round as they do in a riding-houſe, and they are put on the trot; the workmen move the ſtraw from time to time with forks, and then ſet the cattle again to work. This method is tolerably expeditious; but it requires many cattle, and ſpoils the legs of the horſes and mules, which they uſe preferably to oxen or cows.

In other provinces they threſh in the open air with flails; and as this buſineſs requires hurry, ſeveral families agree to work in common, ſo that ten or twelve flails are often ſeen going on the ſame floor; but in either method the corn is threſhed directly after Harveſt.

In provinces where they houſe all their corn, or at leaſt ſtack it, they threſh the grain as they want it, during the courſe of the winter; and they have ſometimes but juſt finiſhed a little before Harveſt, or, at ſooneſt, at Midſummer.

There is an art in placing the ſheaves either in a barn, or on a ſtack; they muſt be laid ſo cloſe to the walls that the rats cannot penetrate into the inſide of the heap.

They generally make ſtacks on high ground: a layer of faggots is firſt put next the earth; over which they put a bed of old ſtraw; the ſheaves are then laid in ſuch a manner that the ſtack reſembles a turret, or a pavilion. Either faggots, or hurdles are ſet round it, to hinder the cattle from eating it, and it is thatched to keep out the wet.

When theſe ſtacks are well made, the corn keeps better in them than in barns; and they are beſides leſs expoſed to damage from rats and mice.

As the Farmers give their ſheep in winter half threſhed ſheaves, and as the freſh ſtraw is good fodder for horſes, it is beſt to threſh the corn by degrees in the courſe of the winter. If this was not put off till then, it would prove very expenſive in Harveſt. It is beſides imagined, that corn improves by laying ſome time in the ſtraw.

But threſhers in a barn muſt be well paid: this is very troubleſome work, and the duſt of the corn has ſuch an effect on their lungs, that many of them dye of pains in the breaſt, or of aſthmas. Theſe inconveniencies might be avoided by uſing ſome machine to threſh corn that might be put in motion by the wind or by a horſe. Several Mechanics have made trials in this matter; but as they were mere theoriſts, their inventions were too defective to be made uſe of.

For long ſtraw to make bands, and for ſeed-corn, ſome ſheaves are ſtruck againſt the convex of a barrel.

ARTICLE II.

Of dreſſing Corn.

When the corn is got out of the ears either by treading of cattle, or threſhing with flails, it muſt be dreſſed, and the chaff broken, and the ears and ſeeds ſeparated from it. This is better done in ſome provinces than others. Our method of proceeding is as follows:

As faſt as the ſheaves are threſhed, the corn falls under the ſtraw mixed with the chaff, broken ears, and the grain which, for want of being ripe, remains in the huſk, and is called the Cobbs. Tho' careful threſhers pick out the moſt viſible weeds, particularly the *Lychnis ſegetum major*, called the Corn Campion, there remains, however, a great many ſeeds mixed with the corn. The threſher having taken up the ſtraw with his fork, and raked up what the fork left, ſhovels from time to time the corn on the floor to one end of the barn, and continues threſhing till he has got a heap large enough to begin his dreſſing.

The corn is then firſt paſſed thro' a ſtrong velum ſieve, with holes one fourth of an inch diameter: this ſieve lets thro' all the corn, cobbs, and ſeeds, retaining only the broken ears, in which however ſome good corn remains. Theſe ears are put among the ſhort ſtraw for horſes.

The ſhort ſtraw is longer than the broken ears, ſome of which are put in the middle of it. They then tye the bundle with two bands, and give theſe bundles to the horſes, which, allured by the grain that ſtill remains in the ears, eat a great deal of the ſtraw, and thrive well on it. In farms where they grow a great deal of Lucerne, or make much hay, this ſhort ſtraw may be kept to give to the ſheep in winter, when it is neceſſary to fodder them.

When all the corn has been riddled, they next caſt it. But before we mention this, it may not be improper to ſay ſomething of a method the threſhers have of eaſing themſelves in riddling. They hang a crotchet of wood by a cord, on this crotchet they put the nooſe of another cord that is faſtened to the edge of the

riddle:

riddle: the cord, by this means, ſupports half the weight of the corn in the riddle, and is no hindrance to the workman giving the riddle the neceſſary circular motion.

Some, inſtead of velum, have wire ſieves, made like ſcreens. This ſieve, which is ſquare, has a thin wooden border, and is placed on two poliſhed iron rods; the corn is thrown with a ſhovel in the ſieve, and by moving it backward and forward on the rods that ſupport it, a great quantity may be riddled without fatigue. I have ſeen ſome of them in France; and recollect that M. Hales invented one not unlike it.

ARTICLE III.

Method of caſting Corn.

To caſt corn properly, the wind ſhould ſet into the barn-door, or into ſome window made on purpoſe in the ſide oppoſite the door.

The corn is laid in a heap over-gainſt the part the wind blows from. At a diſtance from the corn a threſhing-cloth is ſpread; the ſide of it fartheſt from the heap muſt be raiſed with bundles of ſtraw, like a large bolſter of a bed.

The workman then ſtanding near the heap, and, of courſe, under the wind, takes the corn by ſhovels-full, and by a circular motion caſts it like rain towards the oppoſite ſide of the barn. The good grain being heavieſt goes fartheſt, the light corn not ſo far, and the chaff and duſt are driven by the wind towards the workmen: betwixt them and the good corn the cobbs, of ſuch ſeeds as are lighter than the corn, fall; a great deal of the burnt grain falls there alſo, not being ſo heavy as the good corn.

The workman every now and then quits his ſhovel, and takes a whiſk made of ſtraw, with this he moves the cobbs towards the ſide of the floor. If he was to let this alone till the corn was all caſt, they would be too much mixed with the light corn. He alſo, from time to time, fans off the little chaff that might chance to be mixed with the good corn.

When it is all caſt, he gathers the chaff into a heap, ſhovels up the corn from which ſome ſeparate the lighteſt part; and, laſtly, concludes by making a ſeparate heap of the cobbs.

It may be imagined this cannot be done ſo nicely but what ſome good corn will be mixed with the cobbs, and ſome cobbs with

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the chaff; but in ſeparating the heap, they always cut a little on the good corn, which they mix with the cobbs; not only becauſe it is the light corn that lays neareſt them, but alſo becauſe whatever corn is found among the cobbs is afterwards ſeparated. For this reaſon the cobbs have always ſome chaff among them, which are afterwards eaſily ſeparated with the ſtraw-whiſk. The chaff ſerves the cows, and the broken ears are put into the ſtraw-bundles for the horſes; ſo that only two heaps remain on the floor, at leaſt if the light grain is not ſeparated, which would make a third. We ſhall next take notice of what is done with theſe.

ARTICLE IV.

Method of ſeparating grain of different Qualities.

All the good corn is paſſed thro' a ſieve; but if it is intended only to have ordinary Wheat, the holes of this ſieve ſhould be only half a quarter of an inch wide, that nothing may paſs but the ſeeds and off-corn; but if ſeed-corn or choice Wheat is wanted, the corn is paſſed thro' a ſieve with ſomewhat larger holes. Then the Rye, light Wheat, almoſt all the

Corn Campion-ſeed, the wild Garlick-ſeed, the broad-leaved Muſcary, (*Muſcari arvenſe latifolium*) the Fox-tail, the Cow-wheat, (*Melanpyrum purpuraſcente coma*) fall thro' the ſieve, and there remains only the choice Wheat. The workman ſhould have a wing at hand, with which he ſeparates the broken ears, the heads of Garlick, and the wild Fitch pods, which, on account of their lightneſs, are brought in ſifting to the ſurface of the corn.

All theſe ſiftings are mixed with the cobbs, and the clean corn is laid in a corner of the barn covered with a threſhing-cloth to keep it from the duſt.

The ſaving Farmers ſift the light corn to take out the duſt: after which it ſerves for houſhold bread; others ſift this corn in ſieves with ſomewhat larger holes; what paſſes thro' is given to the poultry, and what remains is either ſold as under-corn, or uſed for houſhold bread. We muſt next mention the method of cleaning the cobbs.

Corn that has been cut too green, or has been laid, yields moſt cobbs. The cobbs are generally given to the poultry. Some mix a little of it with the griſt for the family uſe; and it is no bad way, as the chaff ſtays with the bran. When corn is dear, ſome Farmers threſh the cobbs to get out the corn. Laſtly, when Oats are dear, they give the cobbs to the horſes. But whatever uſe is made of them, they muſt be cleaned; which is done with a fan.

The fan commonly uſed is made of oſier, and reſembles a large ſhell, the edges of which on one ſide riſe perpendicularly, and on this part there are two handles. The workman puts ſomething better than a peck of the cobbs into the fan. He then takes it by the handles, ſo that the raiſed ſide may reſt on his thighs. And ſtriking it with his knee, and helping it with his hands, he toſſes the cobbs about a foot or a foot and a half high. As this ſhould be done in a place expoſed to the wind, the duſt and chaff are blown away; but the cobbs, with whatever corn there is among them, ſtay in the fan. Every now and then he ſhakes his fan horizontally, that the ears and a part of the ſeeds may be brought to the ſurface, whence they are taken off with the wing. Theſe are laid aſide for the horſes.

When the cobbs are cleaned in this manner, they are next ſifted to ſeparate the under corn that is among them; this is mixed with the meal for family uſe; the cobbs are ſeparately meaſured, becauſe they pay as well for threſhing them as the good corn.

There are wind-ſcreens which at once ſeparate the cobbs, the chaff, the choice grain, and under corn: a deſcription of them may may be ſeen in my treatiſe on the preſervation of Grain.

There are alſo ſcreens or leaning ſieves to deſtroy the weevils, and drum-ſieves to take off the ſmut; but as theſe are only uſed in granaries, we ſhall ſpeak of them hereafter. We ſhall conclude this with mentioning, that when corn is threſhed in the open air, a fine ſand is often found mixed with it, which makes the bread gritty; and that there is no other method of getting rid of this ſand but by waſhing the corn.

ELEMENTS OF AGRICULTURE.

BOOK V.

Of the Preſervation of Grain.

WHEN by a favourable harveſt the corn has eſcaped the numerous dangers to which it is expoſed in the fields, it is ſtill neceſſary to preſerve it from the damage it may receive in the granary: this will be the ſubject of the preſent book.

If the ſeaſon has not been very wet, and the Harveſt has been dry, the corn being in good condition, is eaſily preſerved, and ſhould preferably be kept for ſcarce years. But if there has been a wet ſeaſon and harveſt, this becomes a matter of greater difficulty. Tho' the corn got in badly ſhould be firſt uſed, it is yet neceſſary to take ſome care that it is not ſpoiled, and to make the moſt of it, always remembring not to delay uſing it: for this tender corn is not only apt to heat by the fermentation occaſioned by its moiſture; but all the inſects that devour corn make great havock in it. We ſhall ſpeak of the particular care neceſſary for ſuch corn; but muſt firſt, in a few words, relate the moſt common method of preſerving grain.

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CHAP. I.

Of the moſt common Form of Granaries.

THE common granaries are a kind of large galleries frequently made in the roofs of houſes over the ground-floor; ſome have thought theſe uſeful, on a ſuppoſition that the air which paſſes thro' the roof is of ſervice to the corn; but as it is expoſed to great heat in ſummer, the inſects that deſtroy corn multiply there without number; and, as they find ſhelter in the roof of it, it is very difficult to root them out. Theſe inconveniences have made people imagine that granaries were beſt level with the ground. It is true the inſects do leſs damage there; but as low places are commonly damp, the corn is very apt to ferment and rot.

The moſt proper ſituation, in my opinion, for preſerving corn, is to keep it in a cool dry place: of courſe it were better to put it in vaulted granaries with windows on each ſide as much as poſſible expoſed to the north and ſouth: theſe windows ſhould have ſtrong outſide ſhutters, which might be opened when the wind was cool and dry, but cloſe ſhut when it was hot and damp. And as whilſt the windows were open, the birds and even pigeons could fly in and eat the corn, it would be proper to have them grated with cloſe wire.

The whole ſurface of the granary ſhould not be covered with corn, which would ſpoil by touching the wall. But a path three feet wide ſhould be left round the heap, and a void ſpace of ten or twelve feet at the entrance, that the corn might be eaſier ſtirred. Half the ſlope that the corn naturally takes might alſo be abridged: but, as in granaries, where no coſt is ſpared, they put at three feet diſtance from the walls a border of wood, which renders a ſlope unneceſſary, I ſhall obſerve

ſerve that a granary ſeventy feet long by twenty-two feet wide, and that has conſequently one thouſand five hundred and forty ſquare feet on the inſide ſurface, ſuppoſing the corn to be laid eighteen inches thick, which is common with new corn, and leaving a path three feet wide, and only ten feet ſpace at the entrance for ſtirring the corn ; I ſay this granary will contain only one thouſand three hundred and ſixty-eight cubical feet of corn ; that is, about three hundred and forty-two *Septiers* (about one hundred and fifty quarters Engliſh).

This ſhort calculation ſhews, that to lay up any conſiderable quantity of corn it would require enormous granaries, at leaſt for the firſt two years ; for the third year they lay it at leaſt two feet thick.

New corn ſhould be ſtirred with a ſhovel every fortnight for the firſt ſix months, and even oftener, if it was put up damp. In the other ſix months, ſtirring it once a month is ſufficient ; in the ſecond and third years it will be enough if it is ſtirred once in three months. This care will keep corn in good condition when it is not attacked by inſects ; but unfortunately this is ſeldom the caſe.

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CHAP. II.

Of Inſects that deſtroy Corn in Granaries.

CORN is generally infeſted in granaries by weevils, baſtard-moths, or by corn caterpillars, much more formidable than either of the other two.

ARTICLE I.

Of Weevils.

The Weevil is a ſmall beetle, or, if you pleaſe, a kind of May-bug; its head is long, and terminates in a point, and its *antennæ* are fixed at the extremity of the head. The Latin name for it is *Curculio.*

As this inſect is black, it is eaſily perceived in corn. They bite the corn, and eat the flour. Some call them Corn-lice, becauſe they bite animals more ſeverely than fleas do. For this reaſon it has been eſteemed a carnivorous inſect, and many have aſſerted, that they devour the worms of the baſtard-moths as well as their chryſaliſes. I am not very far from thinking ſo myſelf; becauſe, in fact, very few baſtard-moths are to be found in heaps of corn where there are many weevils.

By running the hand into a heap of corn, it may eaſily be known by the heat of it, whether there are many of theſe inſects in it.

As it would be rendering a great ſervice to mankind, to find out a ſure and practicable method of deſtroying theſe inſects, one can ſcarcely open a book of Agriculture, without finding ſome receipt againſt weevils. I have tried a great many of them without the leaſt ſucceſs. All that theſe experiments have taught me is, that this animal is very hard to kill: it lives long without eating: cold benumbs them ſo as to make them ſeem dead; but I have kept ſome of them for a little time in a warm place, and have found them full of life: the great coolneſs of my granaries ſeemed to ſtop their encreaſe: but it has not killed them. They bear very well a heat of forty-five or forty-ſix degrees. I have kept for half an hour together corn in which there were many weevils, in a place heated to above eighty degrees: part of them were killed; but ſome ſurvived it. So that when it is propoſed to deſtroy weevils with that degree of heat, it muſt be continued at leaſt ſeven or eight hours.

I allow that the ſteam of ſulphur kills all inſects; but this is impracticable in granaries. This ſteam, which is very light, aſcends to the top of the granaries, and ſcarcely affects the corn near the floor. If by the method I have in another treatiſe mentioned, the corn is laid ſo that the ſteam may penetrate it, all the inſects will, it is true, be killed; but this ſteam gives the corn a laſting diſagreeable ſmell, which renders it of no value. This method is therefore to be rejected.

It is generally thought that weevils may be driven away by rubbing the ſhovels, with which the corn is ſtirred, with ſpirits of turpentine. To try whether this ſpirit was really diſagreeable to weevils, I cauſed two large caſes to be made, one of which was rubbed on the inſide with ſpirit of turpentine; and both of them being filled with corn, in which were many weevils, the inſects remained equally undiſturbed in one and the other. When corn, wherein there are many weevils is ſtirred with a ſhovel, it is true a great part of theſe inſects run from the heap and crowd on the walls. This may probably be attributed to the oil of lavender, or the ſpirit of turpentine: but the ſame thing happens tho' the ſhovel is rubbed with nothing; and the weevils that were diſperſed ſoon reviſit the heap of corn.

When corn is ſifted in a ſieve ſo fine that it will not paſs through; as the weevils by being thus diſturbed cloſe their feet, and are in that poſition generally leſs than good corn, many paſs thro' the ſieve: this is a very good way of deſtroying a great number of them; but unfortunately there ſtill remain enough to do conſiderable damage. Screens made of braſs-wire are generally uſed for this purpoſe: and they receive the weevils and the duſt in a copper-veſſel, that the inſects may not eaſily eſcape.

Of all the methods I have tried, that which appeared to me the beſt was to put the corn in ſtoves or ovens heated to eighty or ninety degrees for a whole day or night. I exhort the public ſpirited to make particular trials to find a method of deſtroying weevils; but I muſt entreat them not to make their diſcoveries public till they have made ſeveral experiments on differents granaries; for I have ſometimes known weevils abandon a granary without its being poſſible to aſſign any reaſon for it.

ARTICLE II.

Of Baſtard Moths.

Baſtard Moths are called by ſome Corn-worms; becauſe the ſtate of life in which they are moſt viſible, is that of a worm about a quarter of an inch long, with ſix feet near their head, which, compared to their body, is very large. Theſe little worms ſpin a very fine web, which covers the heap of corn; this is not viſible but by looking obliquely on the ſpots whereon the ſun ſhines. They are very aſſiduous in this work; for in five or ſix hours after a heap of corn has been ſtirred, it may be ſeen again covered with this very fine web. It ſeems to be a general work among them. When this is done, every worm joins with a ſtronger web five or ſix grains; he fixes himſelf in the middle of them, feeds on the flour, eating ſometimes of one, ſometimes of another. Pretty large lumps of corn may then be raiſed from the heap, owing to the quantity of web theſe inſects have ſpun to join together the grain they were to eat.

When theſe worms have attained their full growth, they change to chryſaliſes, and then to moths, which couple and lay a great number of eggs among the corn.

As this inſect attacks only the ſurface of the heap for about three or four inches thick, ſtirring the corn has been thought to encreaſe the evil: it is certain, however, that it kills but few of theſe animals, ſince the day after the heap has been ſtirred, it may be ſeen covered anew with the web ſpun by them. As they are always found on the ſurface, I thought to have prevented the conſiderable hurt they do the corn, by covering the heaps with hay; but they made terrible havock under it.

It is eaſy to deſtroy this inſect by means of a ſtove heated only to forty-five or fifty degrees. I have tried it on corn full of baſtard moths; and putting it afterwards into a common granary, it remained there two years without ever being infeſted by thoſe inſects; and in the third year, there were very few. It is ſaid that, by ſprinkling corn with lime, a cruſt is formed which protects it from theſe inſects. I have not tried it; but if this method is certain, the corn that compoſes the cruſt muſt ſtill be loſt; and this occaſions a conſiderable diminution, particularly of ſmall ſtores. This conſideration prevented me from making the trial.

ARTICLE III.

Of the Corn Caterpillar.

The Corn Caterpillar is moſt to be dreaded of all the inſects that infeſt our crops. This caterpillar, when it is juſt hatched, and very ſmall, gets into a grain of corn, feeds on the farina, is changed to a chryſalis within it; and becoming, at laſt, a butterfly, lays its eggs on the ears in fields. This laying gives birth to other caterpillars, which becoming butterflies, lay an immenſe quantity of eggs on the corn ſhut up in granaries; whence iſſue the caterpillars that conſume this corn. It is a great misfortune for this dreadful inſect to fix itſelf in a province; the tillage of the land might as well be laid aſide as to have the crops conſtantly become the prey of theſe caterpillars.

I ſhall not enlarge on this ſubject, as M. Tillet and myſelf propoſe giving ſoon a particular account of all the obſervations we have made on this inſect. I ſhall content myſelf with mentioning, that the heat of an oven, or ſtoves heated to ſeventy or eighty degrees is the only practicable method of deſtroying them: it is alſo neceſſary to do it immediately after Harveſt or there will be a very conſiderable loſs. After the operation, the granary muſt be cloſe ſhut, to keep the butterflies that would infeſt the corn from the neighbouring ſtores. I own this method is troubleſome; but it is the only one that has hitherto been attended with ſucceſs.

CHAP. III.

Methods of remedying the Inconveniencies of common Granaries.

IT is evident from what we have ſaid, that a moderate quantity of corn ſpread in large granaries, is liable to be devoured by an infinite number of inſects and ſeveral animals, as rats, mice, and birds, which feed on it; and tho' grain is ſpread thin, it is in danger of being ſpoiled, if not frequently ſtirred, and now and then ſcreened; and this is very expenſive. We ſhall now propoſe ſome method of remedying theſe inconveniencies.

ARTICLE I.

Method of preſerving Grain practiſed in the Provinces where the ſun has great power.

All theſe inconveniencies would be remedied if we could keep corn under ground in a kind of ciſterns, as they do in Gaſcogne, le Vivarais, the Iſland of Malta, &c. In the trial I made of it in the Gatinois, the corn was ſpoiled; to know the reaſon of it I put a certain quantity of corn into a little ſtove which I heated to only fifty degrees; and I perceived that this corn, tho' it was very good when it came out of the ſtove, and in a condition to ſprout, had loſt conſiderably in its weight. Hence I concluded, that in our provinces, which are much colder than the Iſland of Malta, Gaſcogne, and le Vivarais, the grain retained moiſture enough to make it ferment and rot. But this little experiment at the ſame time convinced me, that the ſtove might be very proper for drying grain, and thereby fitting it for being longer preſerved.

ARTICLE II.

Stove for the Preſervation of Grain.

I cauſed a ſtove to be made which I have deſcribed in my Treatiſe on the Preſervation of Grain. But as I only wanted to make one trial, I contented myſelf with having tubes only on one ſide of this ſtove, with an intention, however, of ſupplying the other ſide if I met with ſucceſs in my trial. I was at that time by M. Maréchal, Director of the fortifications in Languedoc, made acquainted with a ſtove invented by M. Intieri in Italy, to dry corn. As this ſtove was differently made from mine, in which I made uſe of tubes, I cauſed the other ſide of my ſtove to be ſupplied with plates like thoſe with which M. Intieri's ſtove was filled. This enabled me to aſſert, that tubes or plates are equally proper to anſwer the end propoſed. Father Pezena has ſince then cauſed ſome ſuch ſtoves to be made; he has very properly obſerved, that the dimenſions of them ſhould be changed, by making them wider but not ſo high, that the heat might be more uniform. I have made this alteration; and propoſe this year ſtill farther to alter my ſtove, to make it, if poſſible, more perfect than it is; for, notwithſtanding the defects I mentioned, it has for many years fully anſwered every purpoſe I ought to expect from it.

The following are the alterations proper to be made in the ſtove deſcribed in the treatiſe on the preſervation of grain.

Fig. 1. (Pl. 3.) preſents a ſection of the ſtove by the line A B of Fig 2. As the air heated by the furnace always aſcends to the top of the ſtove, if the thermometer is at ninety degrees at *a*, it will be at ſeventy at *b*, and at fifty at *c*; therefore, inſtead of making the tubes twelve feet high, as is directed in The Treatiſe on the Preſervation of Grain, I only allow ſix feet from *a* to *b*, Fig. 1. But that the ſtove may hold more corn, I allow in this five feet from *d* to *e*; whereas, in the ſtove deſcribed in the Treatiſe abovementioned, it was only three feet; ſo that this ſtove is ſeven feet deep withinſide *e f*, and is twelve feet wide *f g*. There are two feet *d h* from one preſs to the other: as there are four feet from the piece of wood *b*, to the bottom of the ſtove *c*, and as the higheſt encreaſes towards *i*, the mouth of the furnace ſhould be at *m* (Fig. 2, and 4.) it muſt be conducted from *m* to *n*, then from *n* to *b*; and, laſtly, from *o* to *p*, and from *p* to *q*, where the vertical tube is to *b*, to diſcharge the ſmoke. At *a* (Fig. 4. or 2.) there muſt be a door to go into the ſtove, and to introduce a wheeling furnace (Fig 5.) when the ſtove is to be heated with coal. This ſtove will hold about one hundred Minots, Paris meaſure (about eighty buſhels Engliſh) the tubes being only four inches thick within. To hold a greater quantity, it may be made eight or nine feet deep inſtead of ſeven.

(Fig. 6.) is a ſection of the length of the furnace; *p*, its mouth; *q*, the grate where the fuel is put which burns under an arch; *r*, the little bell-furnace to ſupply the ſtove with hot air; *q*, the riſing and horizontal flue, which carries the ſmoke and the hot air about the inſide of the ſtove; this air enters by the opening *ſ*, paſſes under the furnace *q*, enters into the little bell *r*, and diſperſes itſelf over the ſtove by the flue *ſ*.

The treatiſe which I have publiſhed on the Preſervation of Grain, ſhould be conſulted on the conſtruction of ſtoves and granaries.

I ſhall only obſerve that, as the ſtove extracts the moiſture which makes corn ferment, and at the ſame time deſtroys the eggs of all kinds of inſects, it is abſolutely neceſſary for all ſuch as would wiſh to preſerve corn to be provided with them. The ſtove I have made is only nine feet ſquare within the work, and it contains more than one hundred and fifty Minots, Paris meaſure. As two dryings may be made in twenty-four hours, this ſtove may, perhaps, be thought too large to prepare a ſmaller quantity of corn; but, in this caſe, they may be made of a ſmaller ſize, and even long narrow ovens may ſerve to dry corn, by putting it on a hurdle. The form of ſuch an oven, and of the hurdle ſhall be particularly deſcribed in a work I propoſe publiſhing on the Corn-caterpillar. It is ſufficient in this place to have made it evident how proper it is to dry corn in any manner whatever. Foreigners are well convinced of it; for M. de Montigny, of the Academy of Sciences, who has travelled in the country of Geneva and in Switzerland, ſaw there many ſtoves, and the inhabitants ſpoke greatly in praiſe of them. M. de Verney, who knows by experience the advantages derived from ſtoves, has lately built one at Vangirard, merely with a view of making the public better acquainted with them.

Hitherto we have only had in view the corn intended to be kept in plentiful years to ſupply the public wants in years of ſcarcity; conſequently what has been ſaid ſhould only be underſtood of good corn cut in favourable years and dry harveſts: for it muſt not be forgot, that it would be a vain attempt to think of preſerving long, corn cut in wet years and rainy harveſts.

Some advantage however may be made of this indifferent grain. If this ſoft and damp corn ſhould be ſent to the mill in that condition, it would be cruſhed under the ſtone without being ground, and the flour would ſtick to the bran. On the contrary, when it has been dried, it yields a great deal of flour, and makes much more bread. If there is not an opportunity of immediately making uſe of this corn, but it be kept in granaries, it will be neceſſary to ſtir it very often to keep it from rotting, and to ſcreen it frequently, that the inſects may have no time to fix themſelves in it and devour it. I have experienced that, in this caſe, the corn is much eaſier kept after it has been dried. The ſtove is then of great uſe in years when corn is ſoft and indifferent, tho' the owner ſhould get rid of it as faſt as poſſible. I now return to the good corn intended to be preſerved.

ARTICLE III.

The Kind of Granaries in which the dried Grain muſt be kept.

When the corn has been dried in the ſtove, and the inſects and their eggs all deſtroyed, thoſe in the neighbouring granaries muſt be prevented from approaching it. For this purpoſe the corn muſt be put into tubs or large wooden cheſts fixed on ſtands in a cool dry place. The upper part of theſe cheſts or tubs ſhould be cloſely covered with boards: there muſt only be a few vents left to let out the air when the corn is ventilated in the manner following:

ARTICLE IV.

Method of giving this Grain freſh Air.

After having put the corn into theſe great cheſts exactly cloſed, where it is ſecured from rats, mice, birds, and even inſects that are without, another caution will be neceſſary to preſerve it in a ſtate of perfection; that is, to make a falſe bottom of grating to each cheſt or tub, ſupported by traverſes. Over this grating a ſtrong hair-cloth or canvaſs ſhould be ſtrained; and when the tub is filled, a large pipe is to be fixed betwixt the two bottoms to convey the wind from two of Dr. Hale's large bellows, or ventilators.

When the bellows are ſet to work either by men, horſes, the wind or water, the vent-holes in the top of the cheſt are opened, and the corn contained in it is in a ſhort time perfectly aired.

ARTICLE V.

A general Diſplay of my Method of preſerving Grain.

The ſubſtance of my method, which I have at large ſet forth in the Treatiſe on the Preſervation of Grain, may then be reduced; 1. To drying the corn in ſtoves, and deſtroying the inſects and their eggs; this requires a heat of eighty or ninety degrees of M. Reaumur's thermometer: 2. To putting this corn in very cloſe bins, or cheſts: 3. To keeping theſe cheſts in a cool, dry place: And 4. To refreſhing it, from time to time, with air, by means of large bellows, which may be worked various ways.

By theſe methods, which are by no means difficult, corn may be preſerved: 1. In the ſmalleſt ſpace poſſible; 2. For any length of time;

time; 3. At very little expence; And 4. Without loſs, becauſe it is expoſed neither to birds nor inſects, nor to the many inconveniencies almoſt inevitably attending common granaries.

All the experiments I have made ſince the publication of my Treatiſe on the Preſervation of Grain, have confirmed thoſe which ſerved for the baſis of that work; and I have, beſides, had the ſatisfaction to know that my method has had equal ſucceſs in the hands of ſuch as were willing to adopt it: but among ſuch as approved of it, ſome were willing to diſpenſe with the ſtove, and reduce the operation to the ſimple renewal of the air in the cheſts with the bellows: others were willing to be at the expence of making ſtoves, but did not like the trouble of the bellows. To this I ſay, that correcting the dampneſs of the corn, and preventing it from fermenting, was all that was neceſſary, the uſe of the ſtove might be diſpenſed with in hot countries, by expoſing the corn to the ſun; but even in countries where the ſun has great power, the ſtove is abſolutely neceſſary to deſtroy the inſects. We muſt not then omit having ſtoves to dry the corn by a heat of eighty or ninety degrees of M. Réaumur's thermometer.

It muſt be allowed that corn dried in ſtoves is much eaſier preſerved in common granaries than ſuch as has not been dried, even without the uſe of the bellows, or ventilator, provided it is frequently ſtirred with a ſhovel; but by this method it is ſtill expoſed to rats, mice, birds, and inſects, which ſooner or later prey upon it: ſo that it is much better to ſhut it up in cloſe bins or cheſts, where it may, from time to time, be refreſhed by the ventilator.

As I have no intention of repeating in this place, either what has already been ſaid in my Treatiſe on the Preſervation of Grain, or the experiments contained in the ſeveral volumes of Huſbandry which I have publiſhed ſince 1745, I refer to thoſe works, ſuch as are willing to ſee the ſubject treated more at large, contenting myſelf at preſent with giving only the moſt material part. I ſhall conclude this book with a plain recapitulation of my method of practice.

ARTICLE VI.

Recapitulation of the Method I take to preſerve Grain.

1. In wet years, when the corn is ſoft, it muſt be dried in a ſtove moderately heated, for inſtance, to about fifty degrees: this heat muſt be kept up three or four hours; the vent-holes at the top of the ſtove muſt be then opened to let out the damp vapour; at the end of twenty-four hours the corn muſt be taken out of the ſtove and paſſed thro' a wind-ſcreen to take away the duſt, and afterwards put into a common granary. Corn thus dried grinds well, and yields good flour. It muſt, however, be ſold without delay; for tho' I have kept damp corn dried in this manner ſeveral years, yet it requires a great deal of care and trouble to do it.

2. In hot years and dry harveſts, corn is good and eaſily kept; yet, if it fetches a good price, it is beſt to ſell it without any preparation: but if the price is very low, or there is any particular reaſon for ſtoring it up, the method of doing it is as follows:

1. As faſt as the corn is threſhed and dreſſed, it muſt be put into the common granaries.

2. Towards Whitſuntide this corn muſt be paſſed firſt thro' a common ſcreen, and immediately afterwards thro' a wind-ſcreen; it muſt then be put into the ſtove, which is to be heated to ſeventy, eighty, or even ninety degrees. This heat is to be kept up three or four hours, to kill the inſects and carry off the moiſture. After which the vents at the top of the ſtove are to be left open the whole night that the vapours may diſperſe. The next day the ſtove is to be emptied, and immediately filled again, that ſome advantage may be had from the heat that ſtill remains, and the fire muſt be renewed to the degree above-mentioned.

3. It is to ſave fuel that we do not dry the corn as it is brought from the barn to the granary, and that our proceſs is not begun till all the corn is threſhed; for it requires three times as much wood for the firſt heating of the ſtove as for each of the other times. If the corn is dried in an oven it will be beſt to do it at every dreſſing.

4. When the corn comes out of the ſtove it muſt be paſſed thro' the wind-ſcreen, to ſeparate the duſt which the heat has detached as well as the imperfect grain, which the heat has made very light. This corn muſt be

made as clean as poſſible, as it is not to be moved till it is either ſold or ſent to the mill. The dried corn being thus well cleaned, muſt be ſhut up in very cloſe granaries, or in tubs, or large ſquare cheſts.

5. But great care muſt be taken that no mice are ſhut up with the corn; for if any ſhould be lodged betwixt the two bottoms of the cheſt or granary, it would be impoſſible to deſtroy them, and they would make terrible havock: what are above the corn are much leſs to be apprehended.

6. I have directed above that the cheſts ſhould have vents made a-top, to be opened occaſionally to let out the air when the corn was ventilated; theſe apertures ſhould be covered by a cloſe grating of braſs-wire, that the ſmall mice may not get in whilſt it is ventilating, and the little trap-doors are open. As there is at the bottom of the corn cheſts, an aperture to apply the ventilator, this hole muſt alſo be covered with a braſs-wire grating, to ſtop the entry of mice, when the ventilator is taken away.

7. We have already ſaid, that theſe cloſe cheſts ſhould be kept in a cool dry place, as in a room raiſed about four or five feet above the ground; the cheſts muſt alſo be put on

ſtands ſupported by ſquare ſtones, or blocks of wood.

8. When the air is cool and dry, the corn is to be, from time to time, ventilated, particularly if it feels warm, when the hand is thruſt into it, thro' one of the holes at the top of the cheſt.

9. Laſtly, the outſide ſhutters of the room where theſe cheſts are kept muſt be cloſed whenever the air is hot and moiſt, and opened in cool dry weather.

With this care the corn may be kept in good condition five or ſix years, or more: it will be ſufficient to paſs it once thro' the wind-ſcreen before it is ſold or ſent to mill. I recommend it, however, to the lovers of Agriculture to try every method of deſtroying weevils; but they muſt be careful not to publiſh any receipt as infallible on the report of others; they ſhould not even think themſelves to have ſucceeded till after reiterated trials in various caſes.

ELEMENTS OF AGRICULTURE.

BOOK VI.

Principles and Advantages of the New Husbandry.

WE have hitherto only treated of the methods proper to be followed by ſuch as would wiſh to till their land well, without deviating too much from the cuſtoms eſtabliſhed in the provinces where Agriculture flouriſhes, and where they endeavour to cultivate their farms to the beſt advantage; and I adviſe Huſbandmen to begin by conforming to the principles already laid down before they attempt any new methods. I can venture to ſay they will have room enough for the exerciſe of their ingenuity; for tho' we have ſhewed the ultimate end they are to aim at, yet the means to attain it muſt vary according to the nature of the ſoil, and a thouſand different circumſtances peculiar to every diſtrict. I have beſides, in the provinces I have ſeen, obſerved, that in moſt of them the land was very badly tilled; and that in almoſt all the reſt there were great deficiencies; bad cuſtoms to leave off; and many uſeful methods unknown in theſe parts, but practiſed with great advantage in others, to be eſtabliſhed: in a word, the intelligent, induſtrious, and active Farmer, will always have it in his power to improve Agriculture, and increaſe the advantages to be got from his land.

I do not, however, imagine that I have exhauſted the ſubject of plowing, manures, and ſowing; I am, on the contrary, perſuaded that whoever would attend ſeriouſly to Agriculture might make many uſeful diſcoveries. Neither do I think that the common method, of which I have now given an account, is always the beſt: I am ſo far from being of that opinion, that I have made great progreſs in another method of cultivating land, invented by Mr. Tull, an Engliſhman.

This new Huſbandry, of which I propoſe giving an account in this book, is applicable to many different kinds of plants, and even to almoſt all the fruits of the earth. That we may, however, have ſome fixed object in our account of the new Huſbandry, we ſhall now confine ourſelves to Wheat, as this grain has hitherto engaged all our attention: and we ſhall begin, by making it appear that the advantages reſulting from the new Huſbandry are naturally deducible from the principles laid down in the beginning of the preſent work, when we treated of the common method of Huſbandry. Yet we muſt not diſguiſe that this Huſbandry taken in its full extent is not applicable to every ſoil; and that, as it requires an entire change of old cuſtoms, it ſhould with great circumſpection be adopted.

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CHAP. I.

General Principles of the New Huſbandry, and its Advantages.

THE general principles of the new Huſbandry may be reduced to two principal objects; frequent tillage and the ſaving of ſeed; two points equally profitable to Farmers: this we ſhall make evident.

ARTICLE I.

The Advantages of frequent Tillage.

It may be ſeen in the Second Book how proper it is to prepare land well before ſowing. In the provinces where Agriculture flouriſhes they beſtow ſeveral good plowings on land, to prepare it for the reception of the ſeed of annual plants; but, if we except ſome legumenous plants, the reſt are left to themſelves, till they yield the crop for which they are commonly cultivated. We imagine it would be of advantage to leave this track, and beſtow tillage on Wheat whilſt it is growing, as it is cuſtomary with perennial plants, and as is always done with Maize, Turneps, Carrots, Beans, &c. which would come to little if the ground was not ſeveral times ſtirred whilſt they are growing. This propoſition is naturally deducible from what we have at large ſet forth in the Second Book, where we have laid it down as a maxim, that crops are in proportion larger to the number of plowings that were given before ſeed-time. But it alſo follows, from what we have ſaid in the ſame book, that it would be of great uſe to aſſiſt the plants by tillage,

lage, when they are more in want of nouriſhment: let us ſet this matter in a clearer light.

Let land be ever ſo well cultivated in Autumn, when Wheat is ſowed, it ſinks in the Winter: the particles get nearer together; and the weeds get up which rob the corn of its nouriſhment; inſomuch, that when the winter is over, the land is nearly in the ſame condition as if it had never been plowed. It is, however, at this time that the corn ſhould branch and grow with moſt rigour. It is then in ſpring that plants moſt want tillage, either to deſtroy the weeds, ſupply the roots with freſh earth in the room of that which they had exhauſted, to divide a-new the earthly particles, or to enable the roots to extend themſelves with eaſe, and to collect a great deal of food for the plants, which are then in great want of it.

It is thus evident that, according to the uſual method, the plowings which precede the ſowing, enable the earth to ſupply the Wheat with a great deal of nouriſhment, when it wants very little, as during the whole winter it only ſhews a few leaves; but the Wheat is left to itſelf in a cloſe compact earth, when it ought to be aſſiſted by proper tillage, ſince it is then it ſhould grow with moſt vigour.

It is of great uſe to prepare land intended for ſowing with good tillage: this is made evident in the Second Book: we here add, that theſe preparations are not enough; that we muſt continue to cultivate the plants during their growth, and omit this care till they have attained a perfect maturity.

It is, in fact, every day viſible in gardens, that plants grow vigorouſly when the ground is tilled, or even when they are tranſplanted; becauſe, after they have been confined in the ſeed-beds, they have more room allowed them, and meet with a freſh and well-tilled earth. As much may be done for corn by tilling the earth that is near it. If by this tillage ſome of the roots are moved or broke, the plant receives no injury; for, inſtead of one broken root, it ſends forth ſeveral others. Such as have been neither diſplaced nor hurt, continue to ſupply the plant with food, till the others have again taken hold of the earth. 'Tis then the plant thrives, as the number of mouths are encreaſed in proportion to the new roots ſent forth, as we have evidently made appear in the Firſt Book.

There is no danger of the earth's being exhauſted of its nutritive juices by frequent tillage; we have given our reaſons for this opinion in the Second Book. We willingly allow that the moiſture already imbibed by the earth will not ſo eaſily evaporate from that which is cloſe and compact as from a looſe mould; but this water which ſtagnates may be of more hurt than good to plants; and it is not to be doubted but that the moiſture which evaporates from the well-tilled land, is ſoon reſtored to it by the rains and dews.

But to quit theory, and proceed to facts. Every eſculent plant that droops thrives apace, if the earth about it is ſtirred.

We have ſeveral times experienced that ſickly Wheat would aſſume its verdure after a good tillage, provided it was not done in very hot and dry weather; at ſuch times it would be dangerous to go too near the roots.

The great uſe of tillage beſtowed on plants whilſt in the ground has been proved by an infinite number of experiments made in all parts of the kindgom ſince the publication of my Firſt Volume on Huſbandry; and in ſeveral populous Provinces, they beſtow tillage by manual labour on Wheat whilſt growing. Tho' this is expenſive, the inhabitants find themſelves amply recompenced at Harveſt. It is unneceſſary, therefore, to detain our readers any longer in proving the great advantage of tillage given in theſe circumſtances, ſince the point cannot be conteſted; but it may not be improper to obſerve, that the tillage given to plants whilſt growing is very uſeful to every kind, but more ſo in proportion to the time they occupy the land; thus perennial plants need it more than annuals; and Wheat, which is nine months in the ground, requires this tillage more than Barley, Oats, or Buck-wheat, which occupy the land only three, four, or five months. In fact, Wheat is ſowed in Autumn, after the earth has been well ſtirred by three or four plowings; it ſprouts, and ſhews a few leaves above ground, and produces ſome roots in the earth; if the Winter is mild, it branches; but the rain and ſnow having hardened the earth, in Spring, when the plants ſhould grow with moſt vigour, they droop, their leaves turn yellow, and the ſtalks are ſtarved; inſomuch that Wheat is then often greener and more vigorous in light lands than in ſuch as are ſtronger and of a better quality. But this is not all; for numberleſs weeds take poſſeſſion of the land: the way to deſtroy them and ſtir the hardened earth, is to till it at proper ſeaſons.

It is hence evident that corn ſowed in March does not ſo much require tillage during its growth, as that ſowed before the Winter. If the land has been well plowed before the ſowing of this Spring-corn, it will neither have time to grow hard, nor produce many weeds during the three or four months the corn is on the ground, not having been expoſed to the Winter's ſnow and rain.

We, therefore, do not think that Spring-corn requires tillage during its growth ſo much as Wheat and other Winter-corn.

ARTICLE II.

Of Saving in Seed; its Advantages.

To practiſe the new Huſbandry in perfection, it is not ſufficient to have ſtirred the land well before ſeed-time, and to have kept it in the ſame ſtate of tillage during the growth of the plants; care muſt alſo be taken not to ſow it too thick, that the roots of every plant may have proper room to extend, in order to collect a quantity of food.

We have already ſaid, that plants branch more in a good than a bad ſoil; ſo that leſs ſeed ſhould be ſowed in the firſt than the laſt. As in the practice of the new Huſbandry, plants grow with greater vigour than by the old method, of courſe the land muſt be ſowed thinner, and leſs ſeed than common ſhould be uſed. It is this principle of the new Huſbandry that has been moſt objected to; for, on ſeeing the land occupied by a ſmall number of plants, people are apt to look upon all the vacant ſpace as loſt. But this prejudice will at once ſubſide, on obſerving that, in good land cultivated in the common method, and ſowed very thick, each ſeed produces but one or two ears; that in the ſame land ſowed thinner, every ſeed produces three or four ears; and that a ſingle ſeed which happens to be inſulated often produces eighteen, twenty, or even more, ears. On a trial of the new Huſbandry, it will be found at Harveſt that moſt of the ſeeds have produced twenty, and ſometimes thirty ſtalks loaded with long ears; ſo that if it were poſſible to diſtribute the ſtalks regularly over the whole field, the land would appear well covered.

In the common method, as there are many more plants than can find ſufficient nouriſhment in the land they occupy, and as it is impoſſible to aſſiſt them by tillage, numbers die before they attain their maturity; the greateſt part remain ſickly and drooping, and part of the ſeed is loſt: on the contrary, in the new method all the plants have as much food as they require; and as they are, from time to time, aſſiſted by proper tillage, they become ſo vigorous as to equal in their productions the numerous, but ſickly, plants cultivated in the common method. To make it appear how much ſeed is loſt in the common method, it is ſufficient to obſerve, that every ſeed ſhould produce, at leaſt four ears; that every ear contains, at leaſt, thirty grains; ſo that every ſeed ſhould yield one hundred and twenty for one: yet in a farm worked in the common way they ſcarcely reap four for one. By the new Huſbandry it is eaſy to have eighteen for one; but the real profit muſt not be eſtimated in this manner, as the crop of an acre will not be near ſo advantageous: I ſhall make it evident by the following hypotheſis.

I ſuppoſe that in a ſquare rod of land (the rod being twenty-two feet) one ſeed only is ſowed in every foot ſquare; the whole rod will then contain four hundred and eighty-four ſeeds. As the plants which theſe ſeeds produce, will be well tilled; and as they will have a great deal of ground to extend their roots, every ſeed will produce, at leaſt, ten ears; ſo that we may reap four thouſand eight hundred and forty ears; and ſuppoſing each ear contains thirty grains, it will amount to one hundred and forty-five thouſand two hundred in all; that is, three hundred for one.

Let us now ſuppoſe the ſame extent of ground ſowed with one ſeed in every ſquare inch; this will amount to ſixty-nine thouſand ſix hundred and ninety-ſix ſeeds; and as they will have but little room to extend their roots, each will yield, for inſtance, only two ears: the crop will be one hundred and thirty-nine thouſand three hundred and ninety-two ears; that is, one hundred and thirty-four thouſand five hundred and fifty-two ears more than in the firſt caſe: and if every ear contains thirty grains, the number will amount to four million one hundred and eighty-one thouſand ſeven hundred and ſixty, or four million thirty-ſix thouſand five hundred and ſixty grains more than in the firſt caſe; tho' in this ſpot every ſeed has produced only ſixty inſtead of three hundred. This will, I imagine, be ſufficient to make me underſtood.

ARTICLE III.

Method of practiſing the new Husbandry by Hand-hoeing.

In a well-peopled country, where labour is cheap, the practice of the new Huſbandry is very eaſy.

Suppoſing a field to be in good tilth, and well manured, there are three principal means of getting a good crop; and theſe means cannot be put in practice but in the new Huſbandry.

1. Land muſt be ſowed ſo thin as that every plant may have room ſufficient to extend its roots to collect plenty of food.

2. Every plant muſt be put in a condition of branching and bearing many ſtalks.

3. Every ſtalk muſt be enabled to bear a fine long ear filled to the very end with grain.

That every plant may have ſpace enough for the extenſion of its roots, and that the land may be the eaſier tilled during the growth of the plants, the field, after being well plowed and harrowed, muſt be divided according to the pricked lines *a b* (Pl. 2. fig. 11.) at thirty inches diſtance one from the other; and on the two ſides of each of theſe lines, two rows of Wheat *c d* muſt be ſowed at ſix inches diſtance from each other. By this means there will be an interval two feet wide betwixt the rows *c* and *d*. It will be ſufficient if the ſeeds of Wheat are an inch one from the other in the rows, a little leſs if the ſoil is not very proper for Wheat, and ſomething more if it is very rich and good. By this method every plant in the rows; and in the intervals will have ground enough to ſupply it with whatever food it may require; and the intervals will afford room enough to till the earth whilſt the plants grow: but it is of importance that theſe ſtirrings be given at proper times, as each is to have its particular effect.

The firſt ſtirring, which ſhould be given before the Winter, is not only intended to drain away the wet, which would greatly prejudice the plants, if it was to remain long near the roots, but alſo to diſpoſe the earth to be mellowed by the froſts. Theſe two ends will be anſwered by drawing two ſmall furrows at a little diſtance from the rows, and throwing the earth taken from the furrows into the middle of the intervals: the proper time of giving this is when the Wheat is in leaf.

The ſecond ſtirring, which is intended to make the plants branch, ſhould be given after the hard froſts are over. It will have this effect if, when the ſeverity of the Winter is paſſed, after having ſtirred the earth a little near the rows, that which was thrown into the middle of the intervals is turned back into the furrows; this earth, which has been mellowed by the winter, ſupplies the plants with excellent food, and in a little time the roots may be ſeen to extend in it.

The third ſtirring, which ſhould invigorate the ſtalks, muſt be given when the corn ſpindles, and the ears begin to ſhew themſelves; this ſtirring ſhould be ſlight, yet the middle of the interval may be a little hollowed. It is of ſo little importance, that it may often, without any bad conſequence, be entirely omitted. This is not the caſe with the next we ſhall mention.

The laſt ſtirring is of the moſt importance, as it enlarges the grain, and cauſes the ears to fill at their extremity; it ſhould be given when the Wheat is in bloom: and as the corn is then got to a height, it will be ſufficient to draw a furrow in the middle of the interval, and throw the earth to the right and left on the foot of the plants. By this means the ground is prepared for the next ſowing, as the ſeed is to be put in the middle of the ground that formed the intervals: and the corn, when in ear, is ſupported ſo as to prevent its being laid, tho' we may affirm, that corn raiſed in this manner is, in general, leſs ſubject to be laid than any other; becauſe the ſtraw is hardened at the foot by the action of the air: it is on this account that a tuft of inſulated corn is ſcarcely ever laid.

By this ſucceſſive tillage good crops will be obtained, provided the weather is not very unfavourable.

A vigorous plant is well known to be later in its maturity than one that is ſickly and weak: on this account corn raiſed in the new way is later ripe than any other; it is therefore proper to ſow it a little ſooner than corn raiſed the common way.

Suppoſing the crop got in, this ſame field is to be ſowed with Wheat the year following, and even every year, as the ſeed-rows are to be in the middle of the intervals which had been tilled during the whole year without bearing any thing. Thus, to have a juſt idea of the new method, we muſt imagine the land to be divided into two portions; one of which bears Wheat, and the other,

which

which lays fallow, is tilled without bearing any thing, that it may be ready for ſowing Wheat the enſuing year. All the difference is, that in the old Huſbandry the fallow is entirely detached from the land that is in Wheat: on the contrary, in the new method the fallow is laid out in ſtripes, called Intervals, in the field that is in bearing; which is alſo divided by other ſtripes, called Rows; and the advantage derived from this mixture of rows and intervals is, that the tillage beſtowed on the intervals invigorates the plants that grow in the rows.

In order to prepare the intervals for ſowing, if it is intended they ſhould be mended, ſome well-rotted dung muſt be laid at the bottom of the large furrow made in the middle of the intervals, and this dung muſt be covered with the earth that was before thrown towards the rows of Wheat. If the land does not want mending, the deep furrow is filled without any dung being laid; this ſhould be done immediately after Harveſt, that there may be time to give the land a ſlight ſtirring before the two rows of Wheat are ſowed that ſhould occupy the middle of the ſpace that formed the intervals; and the intervals of the ſecond year take up the ſpace occupied by the ſtubble of the firſt crop.

It ſhould be obſerved,

1. That if it is intended to mend the land for the ſecond crop, it takes up very little dung, as it is only required to put a layer at the bottom of the furrows, which are thirty inches aſunder.

2. That the uſe of dung the ſecond year may very well be diſpenſed with; for if the earth of the rows that bore the Wheat was good, that of the intervals muſt, of courſe, be better, having been fallowed and well tilled.

3. That the Wheat of the ſecond year is finely ſituated, being on a fallow twelve or fifteen inches deep, owing to the deep furrow made in the middle of the intervals. Thus the corn ſhould ſucceed the better the longer the land has been cultivated in the new method.

In other reſpects the work of the ſecond year is a repetition of what was done the firſt.

4. We would not have our readers diſcouraged at the number of ſtirrings we propoſe; for at each of them but a very ſmall quantity of earth is moved. At the firſt ſtirring, to open the furrows *a a* (Pl. 2. Fig. 12.)

along the rows, and lay the earth in the middle *b* of the intervals, the earth *a a* alone is moved and carried to *b*.; at the ſecond ſtirring the earth *b* is turned back into the furrows *a a*. If the third ſtirring is not omitted, it is but ſlight: at the fourth and laſt ſtirring the earth *c* is raiſed and thrown towards *d* and *d* (Fig. 13.) ſo that each time a third of the earth, at moſt, is moved. With reſpect to the ſtirrings that are given at Harveſt to prepare the land for ſowing, nothing hinders the common plow from being made uſe of, which will turn the earth *d d* into the furrow *c*.

5. It would be very troubleſome to ſow the two rows of Wheat, grain by grain: we ſhall in the courſe of this work give a deſcription of an inſtrument called a Drill, which does this work with regularity and diſpatch; but care muſt be taken to put only rotten dung at the bottom of the furrow in the intervals, leſt the long ſtraw ſhould entangle with the ſhares of the drill.

6. The new Huſbandry is no ways troubleſome to practiſe with the hand-hoe, in the manner I have juſt deſcribed, and the ſucceſs is certain. It would be very advantageous if this ſame Huſbandry could be prac-

tiſed with common plows drawn by oxen, horſes, or mules; for in many provinces day-labourers are ſo ſcarce, that it would be impoſſible to give the neceſſary ſtirrings with the hand-hoe. It is not impoſſible to do this with the plow, ſince ſome careful, induſtrious, and intelligent Huſbandmen have done it: but it muſt be confeſſed it is much more difficult than hand-hoeing: I adviſe ſuch as are not reſident on their lands, ſo as to overſee all their own works, not to attempt it. I ſhall, however, give an account of the method of doing it, for the benefit of ſuch induſtrious and active Huſbandmen as are willing to put it in practice.

ARTICLE IV.

Method of practiſing the New Husbandry with the common Implements.

1. This Huſbandry muſt not be attempted in lands that are difficult of tillage; for as there is no remedy that is adapted to all diſeaſes, ſo is there no Huſbandry that agrees with every ſoil. A Land-owner ſhould be attentive to all the improvements that are offered in Agriculture, that he may be qualified to adopt ſuch as beſt ſuits the nature of his land.

2. This Huſbandry, profitable as it may appear, muſt not be undertaken till lands are brought into good tilth.

In the tours I have made, I have met with very ſanguine Huſbandmen, who have been in a great hurry to get the implements proper for the new Huſbandry, without thinking whether they could make any uſe of them; thus have theſe implements remained idle under the cart-lodge. In going over their lands I ſaw them badly cultivated; broom, heath, and ruſhes every-where to be ſeen. Theſe half-tilled lands were hard, compact, full of clods, and an amazing quantity of ſtones. As they had only ſcratched the ſurface, theſe fields had no depth of mould, and the inſtruments of tillage made uſe of were very imperfect. I adviſed the owners to root out the weeds by good and frequent plowings; to improve their inſtruments of Huſbandry, which were ſo imperfect; to give ſome depth to their land; to find means of getting good manure; and finally, to practiſe with attention and induſtry the old Huſbandry, and drain their lands by ditches and trenches made to carry off the water.

When you have, ſaid I, begun by effecting all I have ſaid, you may then, if you think proper, try the new Huſbandry. But it is abſolutely neceſſary to practiſe the old Huſbandry in perfection, before the new method can be undertaken.

3. As it is impoſſible to ſtir the land with a plow in intervals that are only two feet wide, three feet, at leaſt, muſt be allowed; and that the land may yield nearly the ſame crop, three rows of Wheat muſt be ſowed inſtead of two; but as the middle row will not be ſupplied with much food from the earth of the intervals, ſeven inches muſt be allowed betwixt the rows. Thus the rows and the interval will be together about fifty or fifty-two inches wide.

We ſhall give an account of the method of laying out a field to be ſowed in the new Huſbandry.

ARTICLE V.

Summary of the neceſſary Works in the New Husbandry when it is executed with the Plow.

1. I ſuppoſe a drill, a plow proper to work betwixt the rows, and a cultivator, to have been provided; the laſt, indeed, may be diſpenſed with, but the firſt are abſolutely neceſſary.

2. The new Huſbandry may indifferently be begun either with the Winter, or Spring-corn; but the methods vary. I ſhall begin with what relates to the Winter-corn.

3. The land muſt be prepared by four good plowings given at different times; that is, from the beginning of April to the middle of September.

4. Theſe plowings muſt be given in dry weather, that the earth may not knead.

5. The land muſt be harrowed in fine weather to make it level, in the ſame manner as if it was ſowed in the common way.

6. It is neceſſary that the rows of Wheat ſhould be ſowed very ſtraight, and this cannot be done without ſome trouble; but this ſhould not diſcourage the Huſbandmen, as it is only the firſt time of ſowing that ſo much care is needful. When the land has been once ſowed in ſtraight rows, it is very eaſy to ſow it regularly every year afterwards.

7. If the field is not very large, a line muſt be ſtrained acroſs it, by which a rill may be traced with a hoe for the horſe that draws the drill to go in; and if three rows are ſowed, care muſt be taken to leave fifty inches ſpace betwixt the rills,

8. If the field is large, ſtakes muſt, at the two ends, be ſtuck at five feet diſtance; and the workman is then with a plow without an earth-board to trace a ſmall furrow for the horſe to go in that draws the drill, directing himſelf with his eye by the ſtakes.

9. Matters muſt be ſo ordered as that the land may be ſowed by the middle of September, or, at fartheſt, by the end of that month.

10. The furrows muſt be traced the long way of the land, that as little ſpace as poſſible may be loſt in head-lands.

11. It will alſo be proper, if it can be done, to make the rows run down the ſlope of the land, that the water may drain towards the bottom of a field, or into a ditch made to carry it off.

12. The Seed-wheat muſt be put into baſkets, and plunged into a tub of lime-water; and the grain muſt be ſtirred, that all the light and bad corn may come to the ſurface and be ſkimmed off: this refuſe, or off-corn, when waſhed, is good for poultry.

13. The limed ſeed muſt then be ſpread on the floor of the granary, and ſtirred, from time to time, till it is dry enough to run thro' the valves of the hopper of the drill.

14. In countries where they are apprehenſive of the ſmut, a lye made of aſhes may be mixed with the lime, as a ſafe-guard againſt that diſtemper, which does conſiderable damage.

15. It cannot but be of uſe to procure ſeed from land that grows the beſt Wheat; and gleaner's corn is to be preferred to any other, as it is quite unmixed with ſeeds, and ſeldom ſmutty.

16. After having filled the hoppers of the drill, the horſe muſt go ſlowly along the furrow that has been traced. That the proper quantity of ſeed may be ſowed, the aperture of the hopper muſt be ſuited to the ſize of the grain; and it muſt be ſo ordered, that thirty, or at moſt forty pounds be ſowed on an arpent of one hundred perches, each twenty-two feet long.

17. As the drill is ſeldom well managed at firſt, the field ſhould be looked over, when the corn is come up, and the deficiencies ſupplied.

18. An experiment ſhould always be made of the goodneſs of the ſeed; and this may be done by ſowing fifty or an hundred grains in a moiſt earth, to ſee if they all come up.

19. Stiff lands that retain the wet muſt have a ſtirring given them in October, in fine weather. For this purpoſe a furrow muſt firſt be opened in the middle of the intervals, which ſhould afterwards be filled by furrows drawn on each ſide, the earth being thereby raiſed in the middle of the intervals, and two ſmall furrows muſt be made near the rows to drain away the wet, which is very hurtful to the Wheat in winter; care muſt, however, be taken not to go too near the rows, for fear of baring the roots, and expoſing them to the hard froſt.

20. About the end of March the firſt ſtirring after Winter is to be given with a light plow, and it muſt be ſo ordered, that the furrows made to drain the rows may be filled by earth from the middle of the interval.

21. Some time in May the rows muſt be weeded; this work may be troubleſome in the firſt years, but will not be ſo afterwards, as by good tillage the weeds will be deſtroyed.

22. In the beginning of June, juſt before the Wheat is in bloom, the ſecond ſtirring is to be given with a common plow, being careful to raiſe the earth againſt the ſides of the rows, and make as deep a furrow in the mid-

dle of the interval as poſſible; and as the corn will be high, it will be ſufficient to paſs the plow twice in the ſame furrow in the middle of the intervals, to deepen it, and earth up the corn.

23. When the Wheat is ripe it muſt be reaped, particular care being taken to trample as little as poſſible on the tilled land.

24. At the end of Auguſt the intervals are to be turned up with the common plow, to prepare them for Wheat; and then the great furrow in the middle muſt not only be filled, but the earth muſt be raiſed as much as poſſible in the middle of the intervals.

25. About the middle of September the land muſt be ſowed with a drill, in the manner deſcribed above in paragraph 16.

26. In October the ſtubble muſt be turned in, for forming the intervals; and what is ſaid in the 19th paragraph muſt be obſerved.

27. The whole field may, it is true, be plowed in Auguſt; but we adviſe the ſtubble to be then let alone, not only becauſe the rows of ſtubble may be a guide to the workman in driving his drill ſtraight; but alſo becauſe the ſtubble may mix with the earth of the intervals where the rows are to be formed, and entangling the little ſhares of the drill,

become very troubleſome whilſt that inſtrument was at work. There are, however, certain caſes, when the ſtubble being very ſhort, no inconvenience can attend turning it in; the whole land may then be plowed; yet the October ſtirring, as directed in the 19th and 26th paragraphs, muſt not be omitted.

28. It is almoſt unneceſſary to obſerve, that the works we have been treating of muſt be forwarded or kept back, according to the ſeaſon; this circumſtance is much governed by the nature of the ſoil.

29. If it is intended to begin this Huſbandry in March, the ground muſt have had three or four good ſtirrings betwixt the Harveſt and that time.

30. The land muſt be harrowed and ſowed in the manner directed from the 7th to the 16th paragraph; and the ſtirring muſt be according to the paragraphs 21, 22, &c.

31. When the new Huſbandry is begun in March, Summer-wheat muſt be ſowed; but if the land had not been before prepared by three or four good plowings, Oats ſhould be preferred; becauſe that grain ſucceeds better then any other on land indifferently plowed.

32. Tho' there there is no occaſion to lay on ſo much dung in the new as in the old method of Huſbandry, it is, however, certain, that manures are of uſe; and I recommend that dung be laid at the bottom of the furrows of the intervals, immediately after Harveſt and before the firſt plowing, that it may have time to rot before the land is ſowed; rotten dung ſhould be uſed that the ſtraw may not entangle the ſhares of the drill: as pigeons dung has not this inconvenience it may be ſpread juſt before the plowing that precedes the ſowing.

I ſhall, in this place, inſert a memoire of M. de Saint-Meſnin de Lignerolle, which will ſet in a very clear light the different methods of practiſing the new Huſbandry.

ARTICLE VI.

M. de Lignerolle's Remarks on the Practice of the new Husbandry.

Let us ſuppoſe, ſays M. de Lignerolle, a field to be well plowed, flat and very level, ready for ſowing; or to be laid in any form. Let us alſo ſuppoſe the land to be good; not too hard to work; and that it is to be laid out in beds of four bouts each, or eight furrows, which yield ſeven rows of Wheat *. As it is the firſt time the land is ſowed in the new way, it muſt be ſo laid out that there may be alternately a ſpace in fallow, and another ſowed; and this apportionment will ſerve as long as the land is cultivated in the new way. As I begin, by leaving on one ſide of the piece a fallow ſpace, I count one, two, three, four, five, ſix, ſeven, eight, nine, and ten furrows of fallow, (Pl. 2. Fig. 13.) and this is to be the interval that is to remain fallow the firſt year, and to be ſowed the year following; becauſe there muſt be ten furrows of fallow to one bed of four bouts, conſiſting of eight furrows, to bear ſeven rows of Wheat. In ſowing, I count one, two, three, four of theſe ten furrows; I cauſe ſome corn to be ſpread by hand on the two fifth or middle furrows, and a part of the fourth furrows are turned by the plow on the fifth furrows which form the middle of the bed; thus the fifth furrows are raiſed by the fourth, by which a trench is formed: by this bout of the plow the ſeed that was ſpread is covered in the middle of the bed; and tho' the ſeed has been ſpread in the two fur-

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* There muſt be at moſt five rows; ſo that we muſt eſteem the ſeven rows, as ſuppoſed.

rows 5, there will be when the corn comes up, only one ſtrong row equivalent to two.

After having ſpread the ſeed in the two furrows laſt made, the fallow is to be plowed ſhallower, and a ſecond bout of the plow covers the ſeed, and forms two new furrows.

Having ſpread the ſeed in the furrows as faſt as they are formed, and having gone a third and fourth bout, the bed is entirely formed of eight furrows, which ſhould yield but ſeven rows of Wheat; the two firſt producing only one, which is, indeed, ſtronger than the reſt.

It is proper to obſerve, 1, That for the beds to drain the water into the parting furrows, they muſt form the ſegment of a circle. It is on this account that the furrows 4, 4, are cut deep, and the earth is turned on the furrows 5, 5, to form the back of the bed or ridge; and the furrows 3, 3, 2, 2, 1, 1, are plowed more and more ſhallow, that the ſlope from the back to the laſt furrow may be regular.

2. That ten furrows of fallow are neceſſary for four bouts of the plow, forming eight furrows in the bed, which bear only ſeven rows of Wheat; becauſe, as we have already ſaid, the back bears only one ſtrong row equivalent to two. If the beds are to be

made narrower, eight furrows of fallow muſt be taken for three bouts of the plow, forming ſix furrows on the bed which bear only five rows of Wheat †. If ſix furrows only were taken for two bouts of the plow, forming four furrows in the bed, there would be but three rows of Wheat: theſe beds are very narrow, and parted by two trenches, When there is only the back formed by two furrows thrown one towards the other, over the two middle furrows which they cover, (what they call) a ridge is formed, which bears only one row of Wheat. It is evident that the plow effects this, firſt, by turning two furrows one towards the other, which ſerve to turn the earth of the following furrows into, to form a bed of any given breadth, this is finiſhed, and bounded by two trenches, into which the two firſt furrows are turned when the land is twyfallowed, and put into the ſituation it was when firſt plowed; in this manner the ſituation is changed in the ſame way as when the land is plowed with the ſhifting-ear plow.

The care we recommend in the firſt plowing is not ſo neceſſary in fallowing or twyfallowing; for as it is not then requiſite to make a ſlope to carry off the water, they form no back, and plow equally deep the whole width of the beds.

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† It is to be obſerved here that, by M. de Lignerolle's method, the beds may be made of any width.

After having, at large, ſet forth the manner of forming the beds properly, M. de Lignerolle proceeds to examine the ſituation of the Wheat that has been ſowed on them. This deſign is to ſet in view the advantages of the new Huſbandry, and to explain the method of forming and tilling the beds cultivated in that manner.

The ſeed that is ſowed on the back, or higheſt part of the bed, ſhould thrive, as it has almoſt the earth of four furrows to ſpread its roots in. The ſeed in the next two rows is alſo well ſupplied with earth. The third rows, which are the fifth of the bed, tho' they have not ſo great a depth of earth as the laſt-mentioned, do not ſucceed badly. But the laſt rows, neareſt the ſide of the bed, are in the worſt ſituation, which at Harveſt is very viſible, as they are much weaker than the others; they ſtand in need more then of that aſſiſtance which the new Huſbndry alone can afford them, by turning a part of the earth of the adjacent fallow towards them; and a ſingle ſtirring in Spring, well-timed, is ſufficient to make the plants on theſe rows as ſtrong and vigorous as thoſe in the middle of the beds.

We ſhall now mention the ſtirrings neceſſary to be given, as well for bringing forward the plants that are growing, as for the preparation of the fallow for ſowing the enſuing year.

I would recommend, continues M. de Lignerolle, the firſt ſtirring not to be given till Spring. It appears from what has been ſaid, that on each ſide the bed there is a trench which, ſeparating it from the fallow, ſerves by way of drain. It is then impoſſible to plow this fallow not only without filling the trench which, during the Winter is neceſſary, particularly in ſoils that retain the wet, but even without turning ſome of the earth of the fallow on the Wheat-plants, which cannot then but have a bad effect. But if, at the firſt plowing, the Wheat ſhould even not be covered, at the ſecond this furrow of the fallow muſt be turned back without damaging the Wheat by the horſes; one of which, with a common plow, muſt go on the laſt row of it: beſides, the plow will tear up the Wheat-plants, as the earth, which had before been thrown towards the laſt row, muſt now be turned back to form the laſt furrow of the fallow-bed; and if, to avoid tearing up the Wheat, this earth is left behind, the laſt row will not be tilled, and the principles of the new Huſbandry will not be put in practice *.

I perceive that this ſtirring embaraſſes all the partizans of the new Huſbandry; yet I ſee no remedy but by ſtirring the land ſeldomer, and letting it be better timed. Provided this is attended to, I will venture to ſay, continues M. de Lignerolle, that the common plow may be uſed, and the horſes in couples, and no damage done; the principles of the new Huſbandry will be obſerved, and all the advantages that could be hoped for will be attained without trouble or encreaſe of expence.

The trench which ſeparates the beds that are planted from ſuch as are fallow, ſerves in Winter by way of drain, ſo that the froſts will mellow the earth, the rains and ſnow will penetrate it without overflowing the Wheat; and this is of great uſe in light lands, to which the new Huſbandry is particularly adapted. By plowing the fallow be-

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* I have avoided this inconvenience by ſtirring the land near the rows with the Cultivator. This is a ſort of plow without an earth-board; it only looſens the earth without turning it over.

fore the Winter, the trench that ſhould ſerve for a drain would be filled, and the advantages we have mentioned be loſt. By the ſecond plowing the roots of the laſt row would be laid bare, and at what time? Why in the Spring, or the beginning of the Summer, at a time when a drowth is to be apprehended, and when the Wheat rather needs earthing up, to defend its roots from the heat of the ſun.

This inconvenience may be avoided by giving the fallow only the common plowings. It ſhould not be plowed in winter; but in Spring, when the land is dry; the firſt thing to be done ſhould be filling the trenches at the ſides, and the plow muſt go deep enough to earth up the plants of the laſt row; and the ſame being done on the other ſide, there will be in the middle of the fallow-bed, when it is plowed, a deep trench, into which the earth of the firſt furrows of the next plowing, which is not to be given till after Harveſt, will be turned. Thus will this bed have the three or even the four plowings given to Wheat-lands cultivated the common way. And if after the Harveſt, and before the twyfallowing, ſome dung be laid on, the crop will be very great, when compared to other fields of the ſame nature *.

We are now come to the ſecond year: our field is laid out for the new huſbandry; but adds M. de Lignerolle there is ſtill one plowing to mention. The bed which bore the crop is a ſtubble, and it would be improper to leave it ſo till Spring; it muſt be plowed as well to lay it level as to mellow the land; and yet the trenches that ſerve for drains muſt not be filled: this is a problem in Huſbandry not eaſy to reſolve. According to M. de Lignerolle the following method muſt be obſerved. It muſt be remembered that the intention of Winter-plowings, that are in the common method of Huſbandry given to lands intended for Spring-corn, betwixt Auguſt and March, is to lay the ſtitches or broad lands on the flat. The bed in ſtubble is high in the middle, having there four furrows laid one upon the other, and the outſide furrows are low in poportion. If what we have already ſaid is recollected,

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* This is a very good method for lands that have been long in tillage, and that are not peſtered with weeds; but if the weeds are troubleſome, the Cultivator ſhould now and then be uſed, this kills the weeds, without interrupting the plowings or baring the roots.

jected, it will be evident, that in a bed conſiſting of four bouts of the plow there are eight furrows, of which thoſe on the outſide are very low, thoſe in the middle very high. Theſe muſt be counterballanced if we would lay the land level. To do this the two laſt furrows, which are the fourth from the middle, muſt not be touched; but the plow muſt be ſet into the third, the earth of which muſt be turned on the fourth, which is the loweſt of all; the ſame muſt be done on the other ſide: by this means two furrows on each ſide are tilled; that is to ſay, one is plowed and the other is covered with fallow-earth. By continuing to plow the next furrows, in the ſame manner, there will only remain the two furrows that formed the back or higheſt part of the bed. This back is then to be ſplit; and laſtly, by turning the plow on the earth-board, and raiſing the ſhare, the balk that was left is thrown into the furrow, and the bed of ſtubble that at firſt conſiſted of ten furrows, is, by this means, laid flat into ſix, without the trenches at the end of the beds being filled. The ſtubble, thus turned, muſt receive a fallow-plowing and a twyfallowing, in the manner above-directed, in ſpeaking of the intervals, or fallow-beds. But at the firſt of theſe plowings, ten furrows muſt be turned, which muſt be afterwards turned back to lay the land as it was at firſt. The bed will have been winter-fallowed, fallowed, and twyfallowed, and this is plowing enough; more would not be of any ſervice; and, if it is dunged, I am apt to think the crop will anſwer expectation.

By plowing in the manner I have directed, the horſes, tho' they are harneſſed, as they are wont to be to the common plow, will always go on the fallow-bed, without damaging that which is ſown. This may even be done in narrow beds, containing only four furrows and bearing but three rows of Wheat. As to ridges, ſays M. de Lignerolle, I make no mention of them, as it is not worth while to practiſe the new huſbandry in lands that require them.

To make the practice of the new Huſbandry ſtill more ſimple and eaſy, and to ſave the expence of a ſower, M. de Lignerolle propoſes that a drill, or ſeed-box, ſhould be fixed to the plow to drop the ſeed at the laſt plowing; and he imagines this way is to be preferred to having a drill with ſeveral ſhares, which cannot work well but on level land. The middle of the bed only, perhaps, would require ſowing by hand; becauſe the plow leaning, in covering the middle furrows, the ſhare does not bite. As the three rows, which we think it proper to ſow in a bed, take up only fourteen inches of land, the drills with three ſhares do their work very well, when they are properly fixed.

Theſe are very good directions for the well-plowing of land in the new way; but, as I have mentioned in more than one place, only general principles can be laid down in books; every one ſhould ſtudy his own land, and endeavour to apply the principles of the new Huſbandry to the nature of it.

ARTICLE VII.

Concluſion; the New Husbandry may be deduced to the Uſe of the Drill alone.

The new Huſbandry is very eaſily practiſed with hand-hoes, or by manual labour; the undertaker is ſure of ſucceeding. But to practiſe it with the common plowing implements is much more difficult. In obſtinate lands no ſucceſs can be expected; and even in ſuch ſoils as are moſt eaſy of tillage, great induſtry is required. Thus, after having a thorough knowledge of the true principles of Agriculture, and a clear perception of the end to be wiſhed for, the means of attaining it are left to particulars to find out. The fundamental principles of the new Huſbandry are known to be true by the ſucceſs of many lovers of Agriculture; but the difficulty of reducing it to practice is equally known by the failure of many others.

I recommend, therefore, to ſuch as mean to attempt it (as I have already done in ſeveral parts of my works) that they ſhould not, at firſt, undertake great matters. It is an arduous taſk to bring men, and even animals to new cuſtoms; it muſt be done by ſlow degrees. To begin with what is eaſieſt, the new Huſbandry may be applied to Lucerne before Wheat is attempted.

But there is another branch of the new Huſbandry, which is much eaſier to practiſe, and is therefore already adopted by many: the manner of plowing is not changed; to ſow the ſeed with greater regularity is all.

Inſtead of caſting it by hand, and irregularly ſcattering it, it muſt be uniformly ſpread, and laid at a proper depth in the earth: this is done by means of an inſtrument, called a Drill, which we ſhall in due time deſcribe. It has already been made evident, that by this method much ſeed may be ſaved, and a better crop procured; this has been repeatedly proved by the experiments of many good Huſbandmen.

We ſhall conclude this Book with ſome anſwers to the objections that have been made to the principles of the new Huſbandry.

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CHAP. II.

Anſwers to the chief Objections that can be made to the Principles of the New Huſbandry.

WHAT we have ſaid in favour of the new Method of Huſbandry, appears ſufficient to engage the lovers of Agriculture to give it a trial; and, according to the good or bad ſucceſs of their firſt attempts, the cauſe of either being known, they may till more or leſs land in the ſame way.

But it is proper to provide againſt the objections that may be made againſt the eſtabliſhment or progreſs of the new Huſbandry. We ſhall, in this place, mention thoſe we have had occaſion to anſwer.

ARTICLE I.

Will not the New Method of cultivating Wheat hurt the Cultivation of Oats, and other ſoft Corn?

Object. I. According to the new Method, all the land being every year in Wheat, the farmer would grow no Oats to feed his horſes nor Barley to fatten his poultry.

Anſ. This is a material objection; however it muſt be recollected that the lands moſt proper for Wheat, are ſeldom very good for Oats; and that ſuch as are beſt adapted to inferior grain, yield very little Wheat. For inſtance, the lands of Beauſſe for the moſt part, bear more Wheat and leſs Oats than the lands of upper Gatinois.

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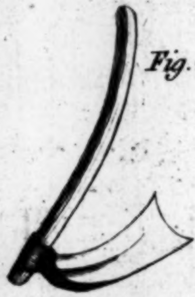


Fig. 2

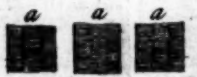


Fig. 3.

Fig. 4

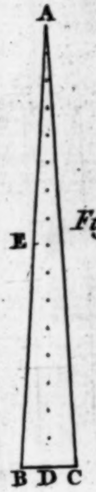
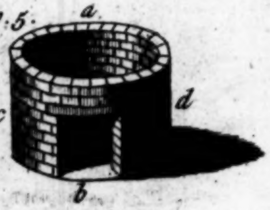


Fig. 1.



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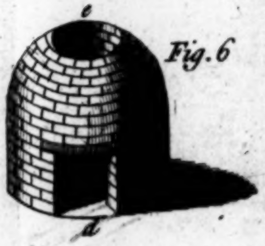

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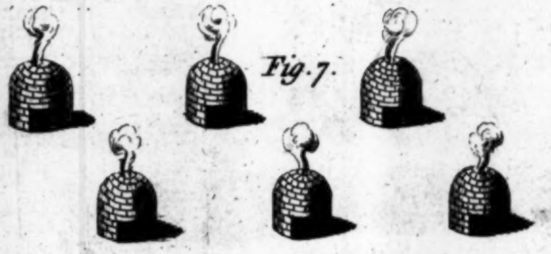


Fig. 7.

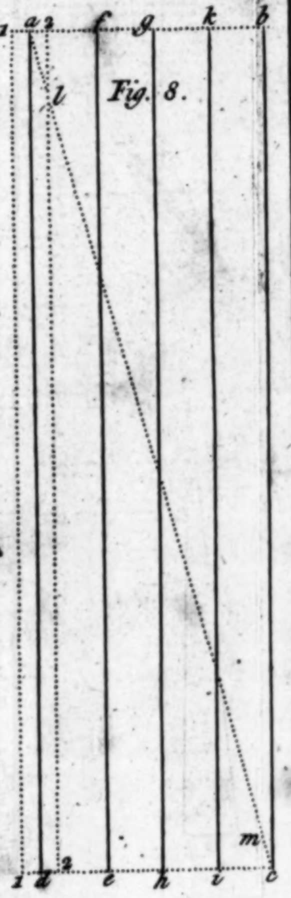
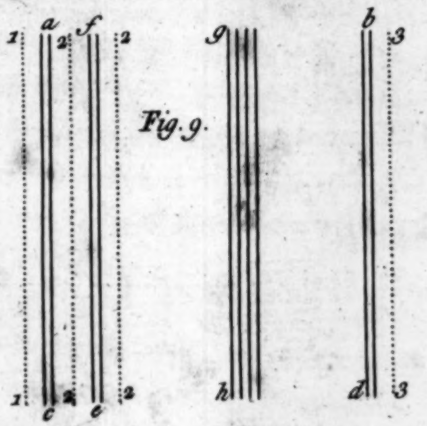


Fig. 8.



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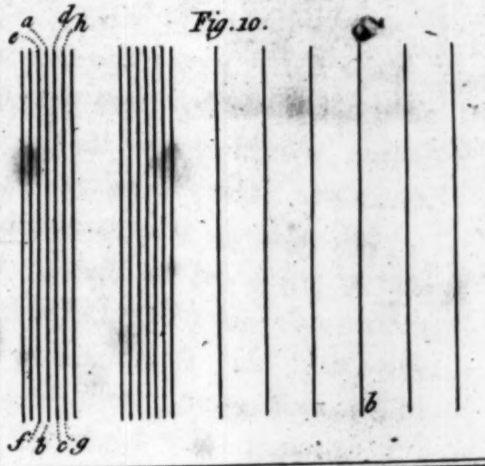

Fig. 10.

J. Ellis sculp.

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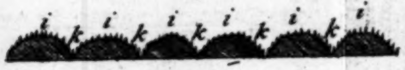

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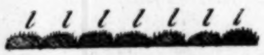

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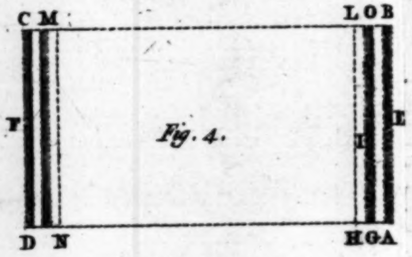

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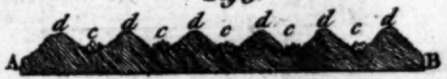

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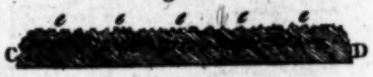

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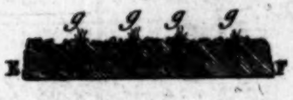

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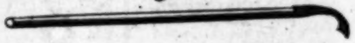

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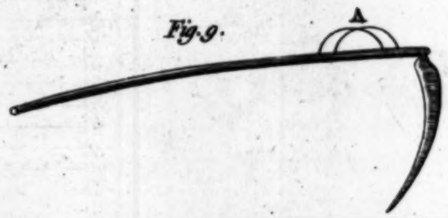

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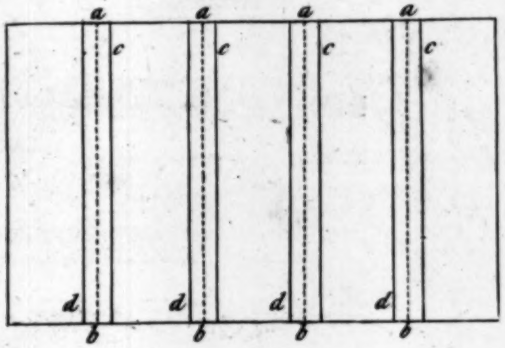

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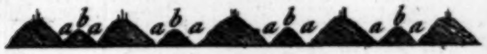

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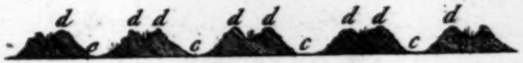

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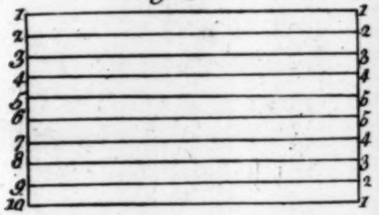


J. Ellis Sculp.

This principle being once eſtabliſhed, it appears to me that it would be for the general good, that all the lands of Beauſſe ſhould be ſowed with Wheat, and all thoſe of the Gatinois with Oats: the Farmers in each province would find their account in it; and the crops being encreaſed, would be a public benefit. But even in the ſame province I have often obſerved, that in a large farm ſome part of the land was very proper for Wheat, and another part fit only for ſoft corn. In this caſe, a Landlord would ſerve his tenant, by permitting him to quit the uſual method of parcelling his land, and ſowing it with the grain that was beſt ſuited to its nature.

What I have ſaid of Oats, may be applied to other ſoft corn; this firſt objection is, I think, therefore anſwered.

ARTICLE II.

Will not the New Husbandry injure the Paſtures?

Object. II. Cattle is an article profitable to the Farmer, neceſſary to the public, and of ſervice to the land, by the dung which enriches it. In the new Huſbandry all the land is in tillage, and continually occupied by the corn; ſo there would be neither ſtubble nor paſtures to ſerve as food for the ſheep and cattle: thus there would be more beaſts, more conſumption of fodder, no dung, no manure for the land, &c.

Anſ. We allow that there muſt be part of the land alotted to raiſing Turneps, and other herbage, which are called artificial Paſtures, to ſupply the wants of the cattle. It is very certain that a ſmall extent of land carefully cultivated in artificial Paſtures, will keep the cattle in very good order.

This aſſertion will not ſeem out of the way, if it is remembered that one acre of good meadow land bears more graſs than ſix acres of fallow or ſtubble; and that a ſingle acre of Lucerne yields more than ſix acres of good meadow-land. This conſidered, muſt it not be allowed to be better to reſerve a ſmall quantity of land to keep the cattle, than to husband all badly to the prejudice of the crop, which is a moſt eſſential article?

Beſides, how many men are there in the kingdom who have only eight, ten, or twelve acres of land, for the tillage of which they pay the neighbouring Farmers; theſe having neither horſes nor cattle, muſt, of courſe, be anxious to encreaſe their crops of Wheat; and they would be very happy if, by the practice of the new Huſbandry they could obtain as good a crop from twelve acres as they could from eighteen or twenty, by following the old method.

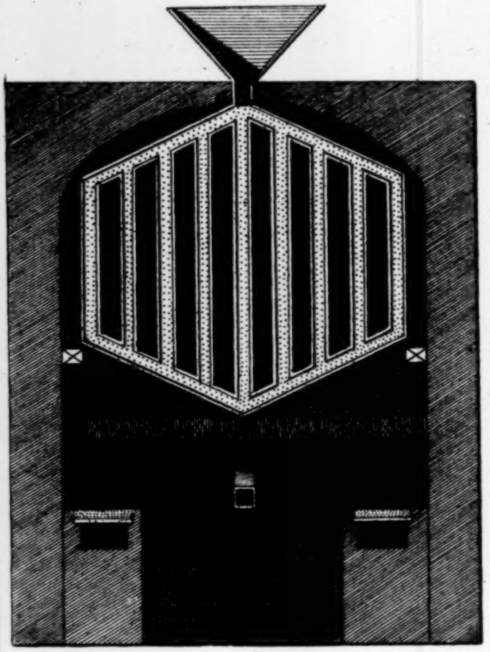
Paſture, it muſt be allowed, is abſolutely neceſſary; but if thirty acres alotted to paſture, properly kept in graſs, will yield more than one hundred acres of heath or land uſed for other crops, as is the practice of populous provinces, it muſt be allowed that the owner gains ſeventy acres of land, which may ſupply him with other profitable articles. Experience has convinced us, that a piece of eight acres of upland paſture, which we plow when the weeds encreaſe too much, which we manure with dung rotted to mould, or with pigeon's dung; which we always keep very ſmooth by beating down the mole-hills, that the ſcythe may cut cloſe; which we trench to carry off the water, and which, laſtly, we have very well encloſed to keep out the cattle, and prevent paths being made acroſs it; this ſmall quantity of paſture, I ſay, of which we have ourſelves the care, ſup-ſupplies us alone with more graſs than thirty or forty acres of graſs-land which we allot to each of our tenants. Yet we here ſpeak only of natural paſtures, merely kept in good order, which do not yield near ſo much as artificial paſtures: We mean, by artificial paſtures, land ſowed with Clover, Saintfoin, Lucerne, grey Peas, Tares, Turneps, Carrots, Cabbages, Potatoes, &c. Let us mention, for inſtance, Lucerne. A good acre of this plant yields, every time it is mowed, more hay than two acres of the beſt paſture; and as Lucerne is generally cut three times in a ſeaſon, whereas natural graſs is cut but once, the produce of the Lucerne is ſix times as much as the natural paſture. And we have obſerved, that the produce of natural paſtures kept in good order is four times as great as heath, or common land; whence it follows, that the produce of Lucerne is to the produce of heath, or common, at leaſt as twenty-four to one. I agree that Lucerne is a plant that bears one of the moſt conſiderable crops of any, and that it cannot be raiſed on all ſoils; yet what proportion is there betwixt our firſt propoſition, by which thirty acres ſhould yield as much graſs as one hundred; and the reſult of the compariſon of Lucerne with heath, ſince we ſee that four acres will yield as much as one hundred? Yet it is not at all in favour of our opinion to call our tenant's paſtures, which begun the compariſon, Heath-land; theſe paſtures are quite exempt from Broom, Heath, Ruſhes, Black-thorn, Brambles, and all the ſhrubs that infeſt the common heaths.

In order to enable the reader to apply this compariſon to the farms of Beauſſe, Picardy, l'Iſle de France, and other well cultivated provinces, it will be ſufficient to obſerve the difference, in the produce of graſs, betwixt land frequently plowed and the moſt indifferent paſtures; but, to give all poſſible advantage to the common method of Huſbandry, let us ſuppoſe that the produce of a good artificial field of Lucerne, for inſtance, is to the produce of fallows and ſtubbles, as twenty-four to one; it will follow that twelve acres and a half of good Lucerne will yield as much as three hundred acres of a Farm in Beauſſe. This reflection very naturally preſents itſelf to our idea.

In a farm of three hundred acres of land in tillage, there are commonly one hundred acres of land very proper for Wheat, one hundred acres of an inferior nature, and one hundred acres of indifferent land: According to the common method of laying out, or parcelling land, the farmer has every year one hundred acres of Wheat and one hundred acres of Oats.

Let us now ſuppoſe that a farmer ſhould allot one hundred and fifty acres of his beſt land, and raiſe Wheat on it every year, according to the principles of the new Huſbandry; his crop of Wheat is then encreaſed by fifty acres, and there will remain one hundred and fifty acres for his crops of Hay and Oats: Let him lay down in artificial paſtures of this portion, not twelve acres and a half, as we have mentioned, but twenty-five, thirty, or forty, if he pleaſes, and the remainder will ſerve him for Oats; his profit will certainly be much larger than in the common method; becauſe every year a part of his artificial paſtures will be ſowed with Oats, and a part of his land inOats be laid down in paſture; and the large crops of Oats that grow on paſtures when they are broke

Fig. 1



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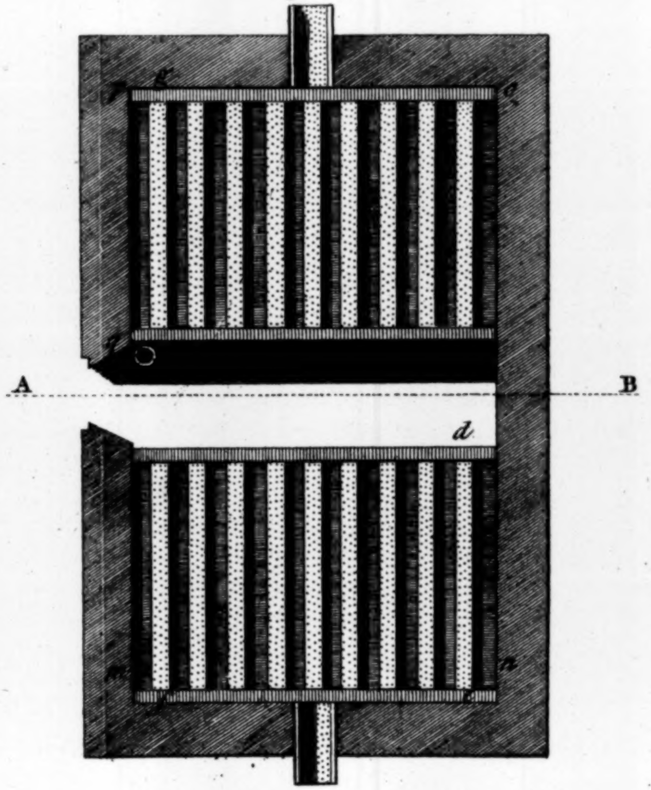
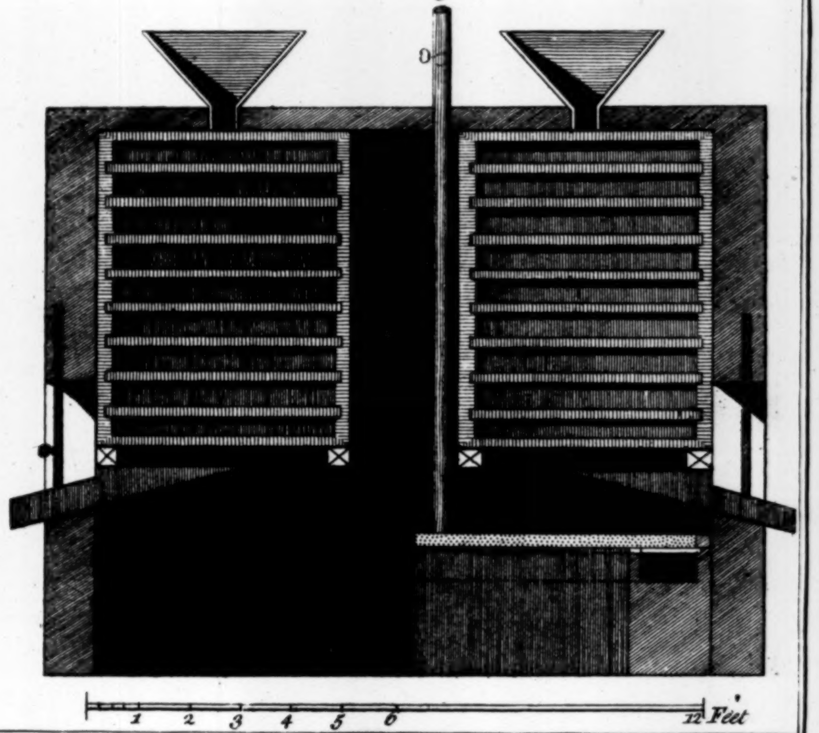


Fig. 3



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broke are well known. Beſides, without diſordering the work of a farm, cannot a portion of good land be laid every year in Wheat, according to the new method?

ARTICLE III.

Is not the New Husbandry attended with a larger Expence than is adequate to the Advantages expected from the Crops?

Object. III. The encreaſe of the crops, ſay they, will be of little value if, in adopting the new method, the expences of working a farm ſhould be greatly enlarged.

Anſ. I ſhall limit myſelf to ſuch general matters as may be ſufficient to people that are well acquainted with the old Huſbandry of Beauſſe and Picardy, which I chuſe by way of compariſon, as I am better acquainted with it than the Huſbandry uſed in other provinces.

A Farmer that has three hundred acres is obliged to have three wheel-plows, which require ſeven ſtrong horſes in land that is not very heavy. He beſtows three plowings on the one hundred acres intended for Wheat. The great Farmers that have ſtrong teams, give four plowings to ſuch part of their land as is moſt difficult to bring into tilth: and this part may be reckoned twelve or fifteen acres. They beſtow two plowings on land deſigned for Barley, Peas, &c. and one to ſuch as is to bear Oats. Some aim at giving two plowings to their Oat-lands. We may reckon the land plowed twice thirty-four acres: thus the Farmer who has three hundred acres in tillage muſt every year plow four hundred and fifty acres. Let us now ſee what plowing is neceſſary in the ſame Farm when cultivated in the new method.

We ſuppoſe the Farmer allots one hundred and fifty acres of his beſt land to be ſowed with Wheat, and that he gives it four plowings; this anſwers to his having ſix hundred acres to plow. Suppoſe the remaining one hundred and fifty acres be cultivated in the old way, and that fifty acres of it, intended for Barley or other tender plants, has two plowings; this is equal to plowing one hundred acres. Laſtly, for Oats, and other crops which require only one plowing, we muſt add one hundred acres more; thus, according to this calculation, there are eight hundred acres to be plowed every year. But as the plowings for the Wheat extend only to the intervals, half the land at moſt will be plowed, which reduces the work to five hundred acres; and, as when the land is brought into good tilth, ſcarcely any of it will require more than a ſingle horſe, the expence of plowing is reduced one half, ſo that we may reckon only one hundred and fifty acres to plow for Wheat; however, as only a part of the land can be tilled with a plow drawn by one horſe, we ſhall reckon theſe plowings equivalent to four hundred and fifty acres, as in the common Huſbandry.

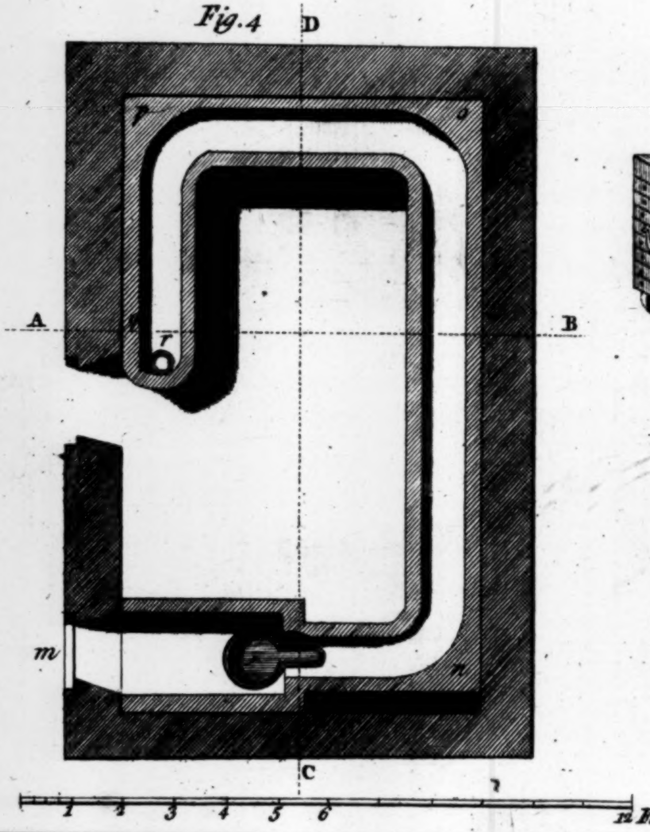
It muſt be obſerved, 1. That we ſuppoſe all the land to be in tillage, tho' the natural paſtures ſcarcely require any work: 2. That a great ſaving may be made in manure, as in our Huſbandry we can mend ninety acres with the ſame quantity that it would require for thirty: 3. That this ſaving in manure will enable the Farmer to mend ſuch paſture-lands as may require it: 4. That this Huſbandry may be extended to Saintfoin, Lucerne, Turneps, Potatoes, Pulſe, Hemp, Flax, as we ſhall notice in the ſequel: 5. That all theſe advantages may with oeconomy be obtained, without any encreaſe in the expences of Huſbandry; have we not then reaſon to hope that ſuch as will not be ſlaves to cuſtom, and that have ſpirit and knowledge enough to overſee the work required by our Huſbandry, may ceaſe forming objections; that they may make trials; correct the miſtakes in their firſt attempts; and, at length, attain the means of practiſing with ſucceſs our principles of Husbandry in their lands; and that they be not fearful of varying, with diſcretion and propriety, from the methods we have laid down, as circumſtances may require?

ARTICLE IV.

Concluſion.

As I had never the leaſt intereſt in recommending the new Husbandry, I readily allow that the difficulties encreaſe in proportion to the extent of land cultivated. A peaſant may put it in practice with eaſe, and be ſure to gain by it. The Farmer, who muſt do the chief of his work with the plow, will have more trouble, tho', in

Fig. 4



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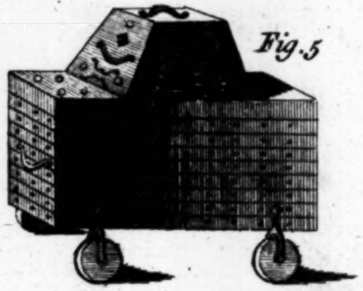
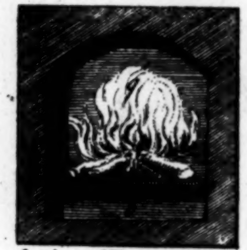
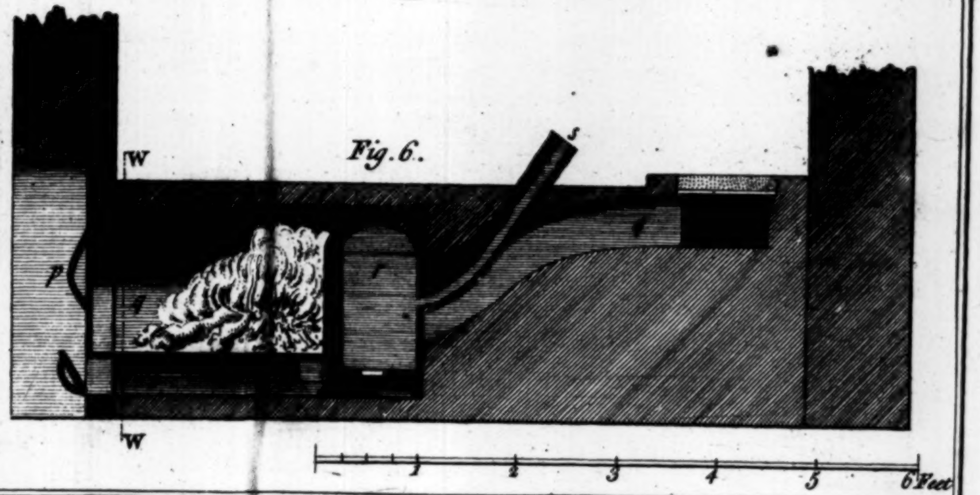




Section of Furnace Fig. 6. by the Line W W.

Fig. 6.



J. Ellis sculp.t

fact, the common method is very little altered, the fallow ground being intermixed with the rows of Wheat. But by this ſingle alteration, whilſt the fallows are prepared for ſowing, the Wheat that is on the ground is benefitted by the tillage. Thus the difficulty conſiſts in plowing with dexterity in the intervals, which are, at moſt three feet and a half wide.

But, in many circumſtances, this Huſbandry cannot be put in practice: 1. In common field land, the ſummer ſtirrings cannot be given without damaging the adjacent land, or too great a loſs of ſoil, particularly in ſmall pieces; for there muſt, at the two ends of the piece, be room for the plow to turn.

2. This Husbandry is quite impracticable in countries where the poor have a right of commonage on the ſtubbles, &c.

3. When this Husbandry is put in practice in the years when the neighbouring lands are in Wheat, all goes well; but the ſecond year, when they are in ſpring-corn; and the third year, when they are in

fallow, the field cultivated in the new way is ſingly in Wheat, and becomes the prey of birds: this inconvenience alone is more conſiderable than would be imagined.

END of the Firſt VOLUME.

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